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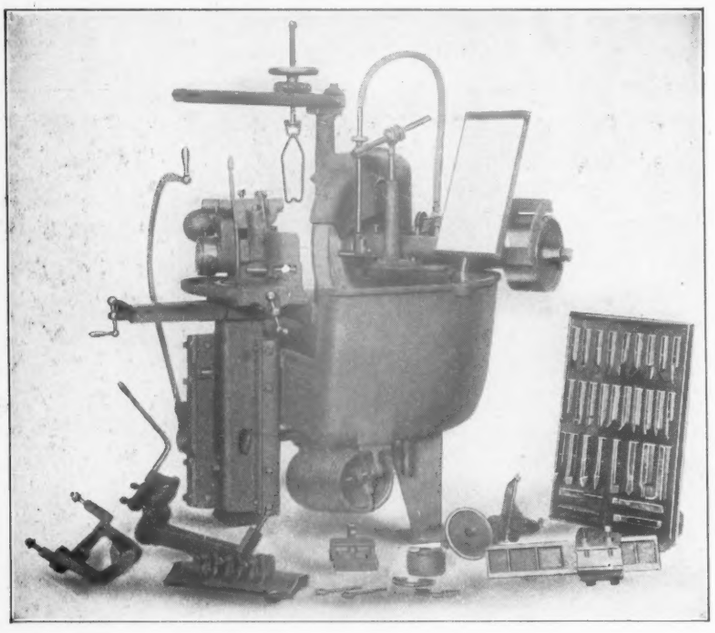

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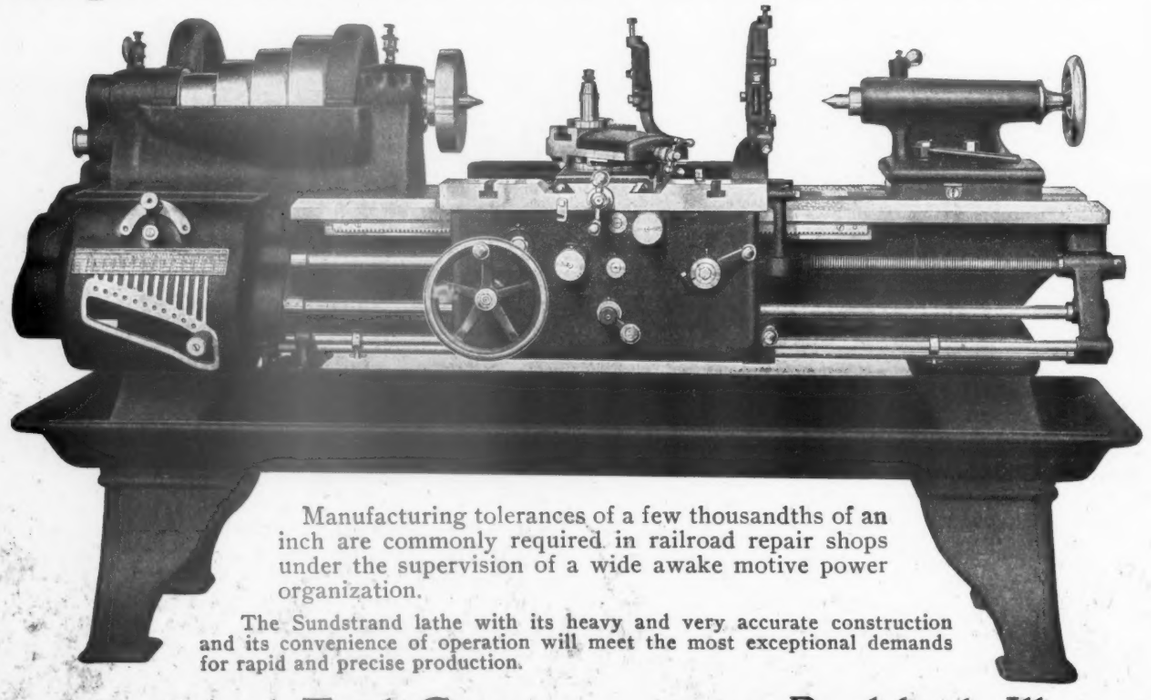

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Railway Mechanical Engineer

Volume 92 March, 1918 No. 3

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Car Repairing Under Government Control

The first order issued by Mr. McAdoo as Director General of Railroads contained the following instructions: "All transportation systems covered by proclamation and order shall be operated as a national system of transportation, the common and national needs being in all instances held paramount to any actual or supposed corporate advantage." In order that the railroads might speed up their work, the government has guaranteed them a net income based on their incomes during the past three years.

Director General McAdoo's order and the provision of the railroad bill to guarantee the net income of the carriers have a very important bearing on the application of the M. C. B. rules. So far as the ultimate financial result is concerned, it would be the same if no repair cards were written. However, it would be inadvisable to stop this practice as the records will be needed and it will be difficult to put the rules into effect again when the government turns the roads back to their owners if no records are kept during the war.

The object of the M. C. B. rules is to place the charges for repairing cars where they rightly belong and this idea runs through all the work on foreign cars. Under the present circumstances the thought uppermost in the minds of those who repair the cars should be to secure the maximum of transportation efficiency, and to provide the greatest possible number of cars to handle the enormous traffic of war time.

There are various ways in which the car department can reduce the number of cars held for repairs. The M. C. B. Association has urged all the roads to repair cars whenever possible without holding them to secure material from the owners. If by making wrong repairs a car can be put into serviceable condition this course should be followed. It is often possible to use some non-standard part and get the car back into service. One shop reports that it repaired 12,049 cars and ordered materials from the owners for only 11. It is important that minor repairs to cars be made as soon as they are required in order to prevent the development of more serious defects. There is a tendency to neglect minor repairs at this time. If the force of inspectors in the yards could be increased so that it would be possible for them to devote more time to making repairs, it would probably keep a great many cars off the repair track.

The object which should be foremost in the minds of the men in the car department should be to secure the maximum of transportation efficiency. The only way to do this is to repair both home and foreign cars with the least possible delay. It is to be hoped that the car situation will soon be improved by the deliverey to the roads of large numbers of new cars. For the present it is important that the car men keep all the equipment they can in condition to do its part for the government.

Keeping Engines Off the Drop Pit

One of the large middle-west roads recently put two locomotives in the back shop for the first time in five years. These engines had not had the driving wheels removed during the period between shoppings. The tires had been taken off the wheel centers and turned to the proper contour and the driving box crown brasses and hub plates had been renewed without dropping the wheels.

When a locomotive is placed on the drop pit to have work

done on the driving boxes it is usually kept out of service for a considerable time. The heavy locomotives now in use require considerable work on the driving boxes. A pound in the crown brass is so serious a defect that it cannot be allowed to go without repairs, and the Federal locomotive inspection rules place rigid limits on the amount of lateral motion which is permissible. Under these conditions it is desirable to have crown brasses and hub plates which can be renewed without dropping the wheels.

Several roads are using removable crown brasses and hub plates, of various designs, with very satisfactory results. Judging from the reports of the performance of these devices they are not expensive to install, are reliable, cost little to maintain and effect large savings in the cost of making renewals. They have proven their worth and deserve the attention of mechanical department officers who are looking for means of securing more service from locomotives and reducing the cost of repairs.

The Present Labor Situation

The condition of power at the present time may be attributed, particularly in the east, to the severely cold weather and heavy snows that have been experienced this winter and to the general inefficiency of labor due to the cold weather and to the great number of changes in the shop forces. With the severe winter back of us, the main problem now is to increase the efficiency of the shop organizations. Never before has there been such a great need for efficient and adequate supervision. The railroads need foremen of strong executive ability to organize and in many cases, to reorganize the shop forces, that efficient work may be done.

The labor turnover during the past few months has been tremendous. New men are constantly coming to the railroads who are unfamiliar with the work. They must be taught and this requires supervision. They must be made to realize the importance of their work. This requires tact and diplomacy. The absentees from the shops must be brought to a minimum. Wages have been increased so that many workmen are satisfied to work but part time. Inducements must be made to keep the men on the job. A particularly good plan which has worked successfully at one point was recently brought to our attention. The day roundhouse men are given a bonus of 15 per cent at the end of the month if they have not been absent from work more than four days during the month without a sufficiently good excuse. The night men are granted a 20 per cent bonus if they meet the same conditions. While this plan has not been in effect for any great length of time, the short time it has been in use has shown a decrease of absentees to about eight per cent, which for this division point is a particularly good record.

It will be necessary to work overtime in order to recover the ground lost during the past two months. D. R. MacBain, of the New York Central Lines, testified before the Railroad Wage Commission that nine- and ten-hour shifts of the workers had been the salvation of his road during the winter. Other roads were not permitted to do this on account of the rigid restrictions placed on them by union labor. In the case of the Rock Island, existing schedules demand time and a half for the ninth hour and five hours pay for the tenth hour. In time of war, with the demand for power so great as it is now, labor unions can show their patriotism in no better way than by permitting any such absurd arrangement to be canceled. The railway shops must be operated to full capacity. They must be adequately supervised and controlled by men of strong executive ability. There is no excuse for such conditions to exist that it is possible for competent foremen to give up their jobs and return to subordinate positions in the shops because they can make more money. Those roads that have permitted their forces to become thus disorganized have followed a short-sighted policy. The increased living expenses and the law of supply and demand have got to be met. Labor must have at its head competent leaders. They are worth their price.

Adequate Facilities Make for Economy

There is a road in the northern section of the United States that has an enviable reputation for good maintenance of brake cylinders, a part of the car equipment that too often is sadly neglected. Some time ago an officer of this road told how the equipment was maintained in such good condition. There was nothing startling about the methods employed; the proper facilities were furnished to the men and they were given comfortable quarters in which to work in cold or rainy weather. The disagreeable features of the work were eliminated and a great increase in the output of the men resulted. No doubt many who read the report regarded it as commonplace and failed to get the big lesson it contained: the economic value of comfortable working conditions.

The present labor situation furnishes the strongest argument that could be advanced for providing good facilities for the workers. The railroads a few years ago were able to get men to work under circumstances that were far from what might have been desired. Many of the men in authority realized that the conditions lowered the efficiency of the workers, but it was so hard to get the money required for improvements that were absolutely necessary, that they could not hope to be able to get capital to devote to furthering the welfare of the employees. The result is that in many places the recent congestion has made the working conditions such that few men will put up with them if they can find employment elsewhere.

The conditions in the average roundhouse make efficient work practically impossible, especially in cold weather. Very few roundhouses have an adequate heating system, or doors that will shut tightly and retain the heat. It is the rule rather than the exception to find pools of water standing on the floor and in the pits. Roundhouse work is hard and dirty at the best. In cold weather with the house full of steam, cold and dirty, no man can do even a fair amount of work. When the number of stalls is inadequate and locomotives must be repaired outside, as has been the case in many places during the past winter, the work that a man can do is reduced still more. Car repairing is done under conditions that are almost as bad as roundhouse work. When car men work under an open shed or with no protection from the cold or rain their production is sure to be low. Even where shops are provided the heating system is often so inadequate or the construction so poor, that in cold weather the men cannot work continuously but must stand around the stoves or radiators from time to time to get warm. Another feature that receives too little attention, is the lighting system. Unshaded lamps hung within the field of vision and often directly in front of the work furnish poor light and by fatiguing the eye reduce the output just as surely as does muscular fatigue. The dirt which settles on electric light globes in a short time reduces their illuminating efficiency more than 50 per cent; therefore frequent cleaning is necessary. In roundhouses cluster lights placed on movable stands are a great improvement over the ordinary extension light.

The conditions existing during the past winter could hardly have been foreseen, consequently allowances have been made for failure to maintain full production. Next winter the government will demand adequate transportation facilities. The railroads cannot furnish them without men to repair the locomotives and cars. If they hope to secure labor in competition with other industries they must see that they

provide decent working conditions. Larger and better equipped roundhouses and shops are urgently needed. The government will undertake to provide capital for the needs of the roads. In planning for the extensions necessary to meet the demands that will be made on them next winter the railroads should not neglect to take into account the fact that failure to provide comfortable working conditions is one of the biggest factors in reducing the efficiency of workers.

The Standard Car

The American roads are about to receive what they have long discussed, but never could agree on—a standard car. As indicated elsewhere in this issue, the Director-General has formed a committee with instructions to *produce* a standard car. The committee has been working industriously and it is believed that designs will soon be submitted. In contrast to the Director-General's committee appointed to investigate the feasibility of designing standard locomotives, the work of the car committee should be easy. A sub-committee of the American Railway Association has been working on the designs for standard cars for over three years. This sub-committee has gone over the situation thoroughly with the car builders and its deliberations and findings should be of material assistance to the government's car committee. It is sincerely to be hoped that it will avail itself to the fullest extent of the work of this sub-committee, as it is highly important that the operating and maintenance features be considered as well as the construction features.

There are differences in opinion as to how far the standardization should be carried. In this regard it is well to consider the reasons for designing standard equipment. Standardization is desirable from the standpoint of cheapness in first cost, adequate strength, interchangeability of parts, reduction of material to be carried in stock and the ease with which repairs may be made. All of these items have considerable weight on account of the number of cars built per year and the extent to which cars are interchanged from one road to another all over the country. These items considered alone, however, are liable to result in overstandardization, which, in a nation so progressive as ours, would be a short-sighted policy. Operating conditions the country over are changing from year to year and we have no assurance that they have yet become fixed. Vast changes have taken place in car construction during the past ten years, all of which have meant a saving in operating costs. There is no reason to believe that we have at the present time reached the height of perfection in car design. In fact, experimental equipment is now in operation which contains many features that will be of value to designers in the future.

The car building industry in the United States is peculiar to the extent that several manufacturers concentrate on building many of the detail parts going on to the car which are commonly known as specialties. These manufacturers have specialized on these particular parts, and due to competition have been forced to develop their products to the highest degree. The well-built modern car today is due largely to the progressiveness of these companies. None of them claim to have reached the zenith of perfection in their products and they are constantly seeking to still further improve them. Now, if by a too rigid program of standardization, these companies are forced to discontinue the manufacture of their products or have the incentive for still further improving them removed, there can be no question but that future development in car construction will be seriously handicapped. Furthermore, and particularly at this time, if these manufacturers of different appliances find it necessary on account of complete standardization of the car to discontinue business, the output of cars would be restricted. At the present time the builders are equipped primarily to erect or assemble cars. They are not equipped to build the entire car. To provide them with the necessary facilities would take time. Either the capacity of their plants would have to be restricted in order to make these parts, or the size of the plants would have to be increased. Even then they would not have the highly specialized organizations for making such parts as is now found in the manufacturers of the special devices which concentrate on each individual part. Furthermore, the specialty manufacturers have provided themselves with materials for their particular devices and have a stock on hand which is available for immediate use and which would do much to speed up the production of cars now.

The most logical course to pursue in the formulation of standards appears, therefore, to be along the lines of standard dimensions and standard strength. By standard dimensions the makers of specialties will be forced to provide equipment interchangeable with that of their competitors and thereby increase the facility with which repairs may be made. By specifying standard strength, a car will be obtained which will meet better the operating conditions throughout the country and as the standards become more generally adopted, will keep many cars off the repair tracks. It will mean the elimination of the poorly designed, cheap car which some roads still persist in building. Such a program of standardization will be welcomed by everyone, both the railroads and public alike.

The Standardization of Locomotives

Reports from Washington indicate that the possibility of the adoption of several types of standard locomotives is receiving considerable attention. The problems of generally adopting standard types of locomotives is one which requires the most careful consideration from many different angles. Under the present conditions the question of paramount importance, however, is—will it materially increase the effectiveness of our prosecution of the war? As a permanent national policy, it may or may not be advisable, but unless it offers the immediate prospect of materially increasing the capacity of our transportation system, beyond what may be done without the introduction of so great an innovation, we are not justified in giving the plan serious consideration at the present time. We now have no permanent national railroad policy. What that policy shall be eventually no one now may definitely predict. The question of the permanent introduction of standard types of locomotives should be left to be carefully weighed as a part of the broader question of our general railroad policy.

At the present time, therefore, we must confine ourselves to the consideration of this matter *purely as an emergency war measure.* There are several apparent advantages, both to the purchaser and the builder which justify careful consideration from this standpoint. If a small number of standard types can be settled upon, there may be an advantage in first cost. The ability to build many locomotives of stock designs gives the builder the advantage in the material market of anticipating the requirements of his customers, without tying up capital in material only suitable for the locomotives of one design and likely to be ordered by one railroad only. Furthermore, it reduces the burden which must be borne by each order of locomotives of a new design incident to the providing of new dies, forms, patterns, templates, etc.

Under present conditions, however, questions of financial economy are of much less importance than increasing transportation capacity. A standard locomotive must of necessity be a compromise designed to meet the average of many varying sets of conditions. Its general use must therefore re-

sult in a loss of transportation efficiency in many cases, due to the necessity for reducing trainloads, and under other conditions where trainloads are determined to some extent by the nature of the traffic and by other facilities, it may even result in a waste of locomotive capacity which cannot fully be utilized. It is therefore evident that the advantages of first cost offered by the plan of standardization must inevitably be obtained at the expense of operating economy and what is of greater importance, transportation capacity.

To the builder the standard locomotive provides the advantages of quantity production and, to a limited extent, continuous operation of his plant at full capacity in anticipation of future orders. It might, therefore, ultimately result in an increased output of locomotives, provided again that the number of standard designs be kept small. A general standardization, however, must provide a multiplicity of designs to meet the requirements for different types and for even a minimum number of sizes of each type. The practical attainment of this apparent advantage is therefore very doubtful and its immediate attainment in time to be a real factor in improving the existing shortage of power is still less probable. The builders' shop programs are practically all laid out for months to come with domestic orders for which material is now on hand or already ordered, and all the preliminary work which is completed for these orders would have to be done before standard locomotives could be built. Equal or better immediate results can be obtained by building duplicate orders of designs already in service.

One of the suggested advantages of the adoption of standard locomotives is the increased facility with which reserve motive power may be mobilized wherever occasion requires. The transfer of standard locomotives, some of which are in service on all railroads, from one railroad to another may be expected to be followed with much less difficulty both in maintenance and operation than a transfer of locomotives standard only on the owning road. To be of greatest advantage in this respect, however, such locomotives must be made quickly available. As the operation of the railroads under government control continues, the general co-ordination of railroad facilities will result in a better control of traffic distribution to prevent local congestions, rather than a shifting of facilities to relieve local congestions. Attention should be directed to building up the power supply where the greatest shortage exists; then keep the power at home. Even the transfer of locomotives from one division to another of the same system, where water and fuel conditions differ, is always attended with many difficulties which take time for straightening out before smooth operation is resumed.

It is, therefore, evident that there are no real advantages of standardization as a war measure. What will it cost in increased operating and maintenance difficulties? Not all of our transportation difficulties have been due to lack of motive power. If the adoption of standard types of locomotives decreases the operating efficiency on some roads by reducing trainloads and hence increasing train movements, the capacity of terminal facilities will still further be overtaxed. Transportation yards are usually rated by their car capacity, but their working capacity is also a function of the number of train movements. The effect of increased train movements upon locomotive terminal facilities already overtaxed, will not result in relieving congestion and delays at this critical point in the transportation machine. Even if train loads are maintained by double-heading the difficulty of keeping up the power and turning it without delay will be increased, and operating costs will go up.

Many roads have been developing their own standards of locomotive construction, in order to secure interchangeability of details. The purpose has been to reduce the amount of stock of renewal parts which must be carried to a minimum and to make possible the making and finishing of these parts on a manufacturing basis. After much effort in many cases it has been possible to carry out these plans to the point where a large amount of special shop equipment has been provided to make possible the economical manufacture of parts. Patterns for many castings are applicable to several classes of locomotives, special turret lathe equipment has been established for the quantity manufacture of motion work pins, many jigs and templates have been provided for performing standard operations, bolt sizes and tapers have been standardized in order that standard drills and reamers may be supplied to all shops and the repair practices for the system retained under effective control. No doubt the seriously disturbing influence which the imposition of a set of universally standard classes of locomotives would have on the organization and efficiency of operation of shops on such roads could in time be overcome, but the wisdom of throwing the burden of such disorganization upon the maintenance departments in a time of national crisis is very doubtful.

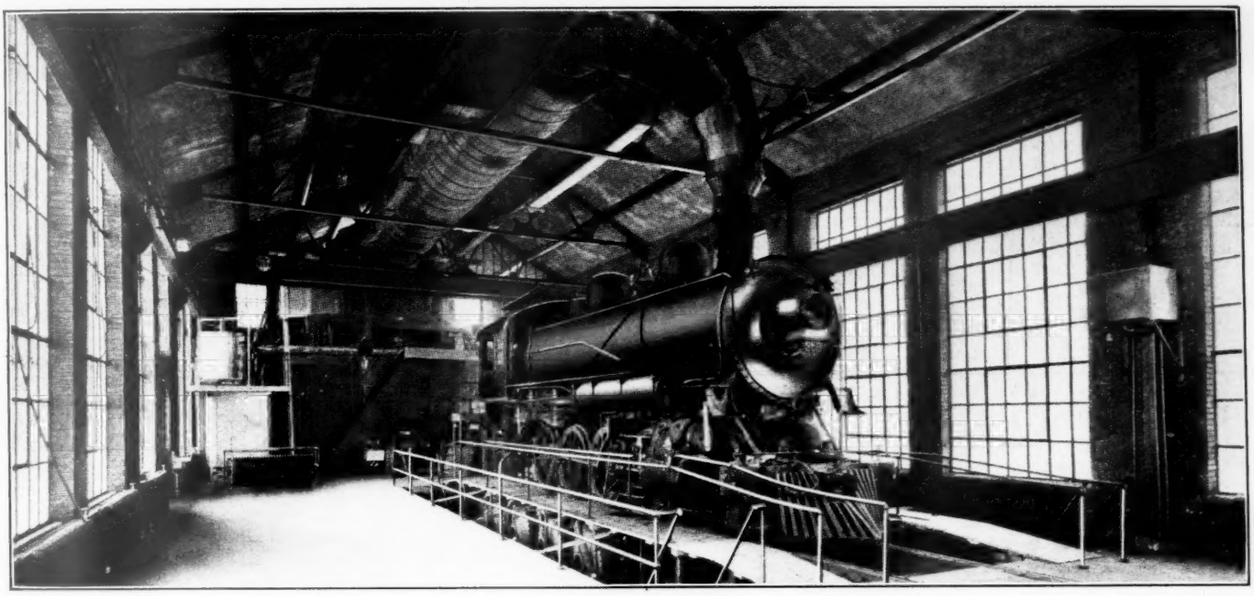
Another matter which should be given careful consideration is the difficulty, generally accompanying the introduction of a new design on any railroad, of effecting the numerous changes in the design necessary before the best service can be obtained from the locomotives. Better results in this respect would be obtained if each railroad were to be permitted to duplicate orders of existing designs which have been thoroughly tried out in service. Following the introduction of standard locomotives it can hardly be expected that any two railroads will find exactly the same changes necessary to best meet their individual requirements. In order to maintain the standards it would therefore be necessary to place rather rigid restrictions on local authorities in the matter of alterations. This would tend to make the locomotives generally unpopular in service and in the shops, and it would be a point of friction which should be avoided at the present time. The fact must not be overlooked that the whole status of our railroad industry was suddenly changed over night and the change is such as to require a complete alteration of the mental attitude of railroad officers and employees generally. Mental habits are strong; they cannot be changed over night and during the period of transition it is highly important to avoid every possible point of friction. Nothing should be done which will tend to discourage men who now are and have been honestly doing their utmost to keep the transportation machine operating smoothly under an exceedingly heavy overload. Nothing is more discouraging than the curtailment of the exercise of local initiative and resource.

If standard locomotives are adopted there is no question but that every railroad man will do his utmost to adapt himself to them. They possess such positive disadvantages, however, that the plan should be dismissed as a war emergency measure.

NEW BOOKS

Shop Expense Analysis and Control. By Nicholas Thiel Ficker, consulting engineer and lecturer on factory engineering and cost production, New York University, 229 pages, 6 in. by 9 in., illustrated, bound in cloth. Published by the Engineering Magazine Company, New York. Price $3.

This book was published to meet the demand of manufacturers and accountants to have in a concise form material on the subject of shop expense which has previously been published by the author in the Engineering Magazine. Eight of the twelve chapters of this book were run as a series of articles in that publication, four chapters having been added to show a more definite application of the subject. The purpose of this book is to provide a means for accurately treating the question of shop expense, sub-dividing it among the proper items in the cost of manufacture and production of work. While it applies particularly to industrial plants, it has many thoughts which will be of assistance in operation and accounting in railway shops.



Interior of the University of Illinois Testing Plant.

INTENSIVE LOCOMOTIVE DEVELOPMENT

The Possibilities of Increased Economy of Operation from More Accurate Knowledge of Principles

BY O. S. BEYER, Jr.

PART I

IT is a significant fact that many of the improvements and economies in operation which railways have been able to effect in the last ten years under the stress of adverse conditions have centered very largely around the locomotive. Previous to this, extensive curvature elimination and grade reduction had received chief attention, involving very large expenditures, justified by the financial conditions which then existed. But with the increasing difficulty of securing ample funds attention to opportunities for further economies was forced into directions requiring less initial expenditure. Quite naturally then the steam locomotive was subjected to scrutiny.

Since the most readily appreciated remedy for the evil of increasing operating expenses has always been the reduction of train mileage by increasing the train load, the first step was to enlarge the hauling capacity of the locomotive. But the limits of this process soon began to manifest themselves. The larger locomotive required more coal and coal was becoming more expensive. Its train grew longer, heavier, more difficult to handle and furnished the train crew with arguments for higher wages. Attention, however, was devoted to these problems with the result that the stoker, brick arch, superheater, reverse gear and other fuel and labor-saving devices were perfected and introduced. Details of construction and operation of the machine itself were improved. As far as the general process has gone, it has developed the modern locomotive, which is accomplishing with a pound of coal and no more operators than the first locomotive ever built, almost twice as much work as the standard product of ten years ago.

The successes thus far attained ought surely to give sufficient inspiration and courage to proceed most aggressively with the further improvement of the locomotive. The extreme necessities created by the present economic situation, aggravated so seriously by the war and bound to continue after the war, make it imperative that the steam locomotive as the principal unit employed in the conduct of the railroad industry be more intensely studied and more thoroughly perfected than has so far been done. Hence it is of interest at this time to present at least some of the most important subjects for investigation vitally concerning the locomotive and to suggest them for immediate consideration and action.

The locomotive problems requiring attention may be classified under the following general heads: (1) Fuel; (2) combustion and steam formation; (3) steam utilization; (4) design and construction, and (5) general performance.

FUEL

Investigations falling under this head are perhaps among the most important of all on account of the great economic importance of fuel in the railway industry. At this critical time particularly, complete or even partial results would be of incalculable benefit. These investigations should primarily contemplate securing data on the relative steaming values of the fuels used in railway service as determined from a complete series of boiler performances, as well as maximum evaporative capacity tests. The data should also include information on the spark and smoke production of the various coals and their clinkering and honeycombing qualities, in order, if possible, to tie up practical performances of coals with the characteristics indicated by proximate and ultimate analyses and other laboratory tests of selected samples. The fuels which should thus be investigated are: (a) Typical coals from all the important mining districts; (b) various commercially sized and some specially sized coals; (c) land-stored, water-stored and freshly mined coal; (d) powdered bituminous, anthracite, lignite coals and peat, and combinations thereof; (e) oil, lignite, anthracite and bituminous

coals, coke, peat, briquets and possible mixtures of these fuels.

Complete information as outlined would enable the railroads more clearly to specify desirable and necessary characteristics of fuel and to select fuels with far more intelligence than can now be done. It would enable them to determine with much greater accuracy the actual value of the various fuels available instead of solving this vital question by the unscientific methods now employed of "collective bargaining" between coal salesman and purchasing or fuel agent.

Such information would also make it possible better to judge the desirabiilty of introducing new methods of combustion, with the object of utilizing fuels not ordinarily burned. It would furnish new information and experience for combustion engineers and other students of locomotive design and operation and in consequence better ways of generating steam by new combustion methods would be suggested and developed. It would serve as a foundation for a more intelligent preparation and subdivision of the ordinary mine run coals into the sizes best suited for locomotive use.

The work already done along this line is lamentably inadequate as compared with the extent of the problem. What is actually known today is but hazy in nature and certainly can not be very scientifically applied. Some tests have been made to determine the relative steaming value of and the maximum capacity obtainable of certain typical locomotive coals and a limited number of different sized coals. One railroad which has developed this data for coal used on its lines has effected economies which have been far-reaching.

The importance of these problems to the stationary power plants throughout the country has been better recognized, and the United States Government, through the Bureau of Mines, has for many years been conducting extensive experiments to help solve them. Several large power producers, prominent among them the Commonwealth Edison Company of Chicago, know exactly what they should pay for each ton of fuel from any mine within the limits of the district supplying them.

It is entirely possible, mechanically, to prepare fuel in a highly pulverized form and burn it in the locomotive furnace. The machinery for doing this has been developed and is in successful operation. The next logical step is to determine accurately just what is the complete economic value of the utilization of pulverized fuel. The many general advantages which are bound to follow its use are, of course, recognized. But it is not known how much, for instance, the evaporation per pound of coal is increased at different rates of combustion. The heat balances over the complete range of boiler capacities of a few typical boilers fired with pulverized fuel have yet to be compared with the balances of these same boilers fired with ordinary fuel. And lastly values as exact as possible of the increase in capacity of the pulverized fuel fired boiler should be established. It is not yet possible completely and finally to judge the wisdom of widely introducing this system of combustion.

COMBUSTION AND STEAM GENERATION

The next group of problems presenting itself has to do with the conversion of the energy in the fuel into that of the steam. Here also are many opportunities for scientific research. A few of the important ones will be considered.

The Chemistry of Combustion.—A detailed study should be made of the chemical reactions taking place during the process of combustion under varying conditions in the different parts of the locomotive furnace, principally throughout the fuel bed. The theory of combustion as it exists to-day applied to the burning of locomotive fuel, is incomplete, and fails to explain the occurrence of some very important phenomena, especially with reference to fires of varying thickness, clinkering, coking, the nature of the higher hydrocarbon products of combustion, etc.

The United States Bureau of Mines has done and is still doing some work in this field, using a model furnace. It might well be extended to a model or actual locomotive furnace, working under locomotive combustion conditions.

Firing Practices.—A far more extensive investigation than thus far attempted should be made of locomotive firing practices, both with and without the assistance of devices for conserving the energy of the fireman, such as automatic fire doors, pneumatic grate shakers and mechanical stokers. The purpose of this should be to determine the most economical combination of practice, devices, and kinds of fuel possible. Maximum boiler capacities resulting from the combinations as well as relative smoke production should be determined.

Heat Absorption.—A detailed experimental as well as mathematical study of the process of heat transfer in the locomotive boiler should be made, especially with reference to the distribution of the heating surfaces between tubes, flues, combustion chamber and firebox. Such a study involves an investigation of gas temperatures throughout the entire boiler from the time the gases leave the fuel bed until they enter the stack. The results would greatly increase the existing knowledge of the proper relation between tube length, diameter, and thickness of wall, particularly as affected by varying initial gas temperatures. A series of tests has been made along this line which indicates that the relation between tube length and diameter for most economical steaming purposes is confined within rather narrow limits. Very much more, however, needs to be done.

Chemical and Physical Nature of Exhaust Gases.—The student of the complicated reactions going on within the locomotive furnace and boiler is immediately confronted by a lack of information needed to assist in explaining some of these reactions. A splendid opportunity exists to investigate the products of combustion as they appear in the locomotive front end, after they have done their work. The results might go a long way toward explaining the mysterious "unaccounted for" losses in the heat balance.

Accurate Smoke Measuring and Indicating Device.—Jointly with the foregoing investigation, attempts should be made to develop accurate locomotive smoke measuring and indicating devices. This can be done in all probability by static-electrical precipitating methods. The ordinary Ringelmann charts frequently used employ arbitrary standards of blackness and are entirely unsatisfactory, as indeed any such method is bound to be when used on a stack where the smoke is quite frequently obscured by the presence of condensing exhaust steam.

The Drafting System.—Tests already made have indicated the great influence of the so-called spark losses on the performance of the locomotive boiler. Some of the factors affecting spark losses are known and others are suspected. Principal among these are draft conditions. An investigation of the entire drafting system of the modern locomotive can not be made too soon. The proportioning of ash pan opening, grate opening, gas areas between the end of the arch and the door sheet, of flues, tubes, the superheater damper, the space under smoke box diaphragm and of the smokestack should all be carefully determined and general values for them expressed in empirical formulae having a wide range of application. This is far from accomplished to-day. Consideration of the relation of these areas is but incidental.

The status of the front end arrangement is in a similar situation. The best that can be said for it as adopted to-day is that a locomotive will steam with it. But that is not sufficient. Aside from the free production of steam, the front end should insure this production with the least waste possible. There are no guarantees that this is actually the case. The front end in the modern locomotive, in the greatest number of cases, is simply a series of adjustments made in a space previously limited, but now further crowded by the introduction of the superheater header. This crowding is only partly relieved by resorting to outside steam pipes. The comprehensive front end tests on the small saturated

steam locomotive conducted jointly by Purdue University and the American Engineer have furnished most of the fundamental data used. However, in view of the vast increase in boiler sizes, accompanied by the further limitation of space in the front end, it is most desirable that these historical tests be repeated on modern power.

The Laws of Resistance to Flow of Gases.—Concurrent with the preceding investigations of the entire drafting system, information should be developed which will establish the laws of resistance to the flow of the gases employed in steam generation through the fire bed, over the brick arch and firebox heating surfaces, through the tubes and over the superheater tubes. Just as careful observations of the flow of air around aerfoils, stream line bodies and other bodies, by means of wind tunnel experiments, have resulted in the important information without which the modern airplane would be an impossibility, so will a similar detailed study of the flow of gases through the locomotive boiler reveal possibilities for reducing their resistance to flow, and perhaps at the same time suggest ways for effecting greater interchange of heat between these gases and the heating surfaces.

Radiation Losses.—Another detail of boiler performance which needs light is that of radiation. Very little is known about this important item, and in consequence losses resulting therefrom are thrown in with those considered as "unaccounted for." It is entirely possible to develop data on this point, especially with the perfected methods of pyrometry now in existence.

Locomotive Feed Water Heating.—After a long period of development the locomotive feed water heater is at last becoming available. As it stands to-day, it is perhaps one of the finest examples of the results of scientific experimentation applied to the solution of locomotive problems. The good work, however, should not stop. As long as feed water can be heated to still higher temperatures, as long as there are heat units still going up the stack which might be saved, the feed water heater investigation should continue.

Locomotive Boiler Performance.—Lastly the whole general subject of locomotive boiler performance needs more study. But unfortunately the available reliable test data covering a sufficient range of performance is entirely too limited for this purpose. Consequently little opportunity exists for developing an extensive and well founded theory of locomotive boiler design. This manifests itself in the wide variation of boiler proportions chosen by different railway companies. It is entirely reasonable that one combination of the many variables entering into boiler construction as applied to each of the general types of boilers, is bound to be better than the present condition of many different combinations, due allowance being made of course for local conditions.

(*To be continued.*)

ACTIVITIES OF THE DIRECTOR-GENERAL

New Appointments Announced; Standard Car and Locomotive Committees; Order Governing Labor

DIRECTOR GENERAL of Railroads William G. McAdoo announced the permanent organization of his railroad staff on February 6 as follows:

Assistant to the Director General, Walker D. Hines, chairman of the executive committee and general counsel of the Atchison, Topeka & Santa Fe.

General counsel, John Barton Payne.

Director, division of transportation, Carl R. Gray, president, Western Maryland.

Director, Division of Traffic, Edward Chambers, vice-of the Atchison, Topeka & Santa Fe.

Director, Division of Finance and Purchases, John Skelton Williams.

Director, Division of Labor, W. S. Carter, president, Brotherhood of Locomotive Firemen and Enginemen.

Director, Division of Public Service and Accounting, Charles A. Prouty, director Bureau of Valuation, Interstate Commerce Commission.

Additional divisions will be created from time to time as conditions justify. The Director General has in contemplation a division on capital expenditures and improvements.

Frank McManamy, chief inspector of locomotive boilers of the Interstate Commerce Commission, has been appointed manager of the locomotive section and is attached to the division of transportation.

The manager of the locomotive section will supervise the condition of, and repairs to, locomotives at all railway shops and roundhouses and at outside shops, in addition to his present duties for the Interstate Commerce Commission as its Chief Inspector of Locomotives.

Henry Walters, chairman of the Atlantic Coast Line and of the Louisville & Nashville, a member of Mr. McAdoo's temporary staff, will continue to act in an advisory capacity.

W. T. Tyler, assistant to the vice-president of the Northern Pacific, and H. T. Bentley, superintendent of motive power and machinery of the Chicago North Western, are acting temporarily as assistants to Mr. Gray in the transportation division. The Commission on Car Service and the Bureau of Car Service of the Interstate Commerce Commission have been merged and are attached to the transportation division.

EQUIPMENT NEEDS

On February 2 the Director General addressed a circular letter calling for complete information as to new equipment, additions, betterments, extensions, etc., already contracted for or which are considered necessary for 1918. The roads are asked to send one copy of the answers with all possible despatch to their respective Regional Directors and the other to the Interstate Commerce Commission.

In determining what additions and betterments, including equipment, and what road extensions should be treated as necessary, and what work already entered upon should be suspended, the roads are asked to be guided by the following general principles:

"From the financial standpoint it is highly important to avoid the necessity for raising any new capital which is not absolutely necessary for the protection and development of the required transportation facilities to meet the present and prospective needs of the country's business under war conditions. From the standpoint of the available supply of labor and material, it is likewise highly important that this supply shall not be absorbed except for the necessary purposes mentioned in the preceding sentence.

"Please also bear in mind that it may frequently happen that projects which might be regarded as highly meritorious and necessary when viewed from the separate standpoint of a particular company, may not be equally meritorious or necessary under existing conditions when the government has possession and control of railroads generally and therefore when facilities heretofore subject to the exclusive control of the separate companies are now available for com-

mon use whenever such common use will promote the movement of traffic.

"While the questions and blanks group together additions and betterments designed to improve capacity, efficiency and economy, this is done because of the difficulty of drawing sharp lines between these objects. It is important to emphasize, however, that under existing conditions the primary thing to accomplish is increased capacity to handle the traffic of the country."

Among the information asked for was the following:

"Submit statement of equipment authorized or contracted for, or the contracting for which during the calendar year 1918 is believed by the management to be necessary for the proper conduct of the business.

"Show the number of units, listing separately locomotives, cars, and other equipment in accordance with the descriptions relating to type and design carried on the blank form; where and by whom constructed; probable time of delivery; estimated probable cost of each unit; and estimated probable cost of aggregate.

"Show in corresponding detail units of equipment which it is anticipated will be retired from service during the calendar year 1918, with the ledger value thereof, and approximately the way in which such ledger value will be disposed of in the accounts."

STANDARDIZATION OF PURCHASES

John Skelton Williams, director of the divisions of finance and of purchases, is to organize a staff of assistants which will be in the nature of a central purchasing board for the railway administration. Samuel Porcher, purchasing agent of the Pennsylvania Railroad, has been temporarily assigned as assistant to Mr. Williams to conduct a general investigation of the general subject of handling railroad purchases with a view to working out a plan, and other railroad officers will be called in to assist from time to time as occasion may require. It is understood that the administration intends to take charge of the purchase of cars, locomotives, rails, oil and other important items of railway supplies which are to be standardized, but it is not the present intention to take over all railway purchases and undoubtedly most kinds of supplies will continue to be purchased by individual railways as at present. The extent to which the administration will take charge of railway purchases will depend largely on the result of the investigation.

STANDARD CARS AND LOCOMOTIVES

Henry Walters, chairman of the Atlantic Coast Line and the Louisville & Nashville, who is acting as special adviser to Director General McAdoo, is in charge of the studies being made for the purpose of establishing standard designs of cars and locomotives to be adopted by the railway administration. Mr. Walters has held numerous conferences with car and locomotive builders on the subject and expects to have several more before anything has been decided.

The committee on cars appointed last summer by the Council of National Defense, at the time when it was proposed to have the government buy freight cars for the railroads, has been delegated to investigate the question of freight car standards. The car committee consists of S. M. Vauclain, vice-president of the Baldwin Locomotive Works; W. H. Woodin, president of the American Car & Foundry Company; J. M. Hansen, president of the Standard Steel Car Company; N. S. Reeder, vice-president of the Pressed Steel Car Company and Clive Runnels, vice-president of the Pullman Company.

The committee on locomotives appointed last summer by the Council of National Defense, of which S. M. Vauclain, vice-president of the Baldwin Locomotive Works, is chairman, has also made a report recommending several standard types of locomotives to Mr. Walters. The recommended standards were then referred to a committee of railroad motive power officers, consisting of three appointed by each regional director, for their consideration and report. The railroad committee has been holding conferences on the subject since February 22 and will report back to Mr. Walters.

H. T. Bentley, superintendent of motive power and machinery of the Chicago & North Western, now acting as assistant to C. R. Gray, director of the division of transportation in the Railroad Administration, has been appointed chairman of the committee and the other members are as follows: Eastern district, H. Bartlett, chief mechanical engineer, Boston & Maine; William Schlafge, general mechanical superintendent, Erie; and H. L. Ingersoll, assistant to the president, New York Central; Southern district, R. W. Bell, general superintendent of motive power, Illinois Central; W. H. Lewis, superintendent of motive power, Norfolk & Western, and J. Hainen, assistant to vice-president, Southern Railway; Western district, Robert Quayle, superintendent of motive power and car department, Chicago & North Western; W. H. Wilson, assistant to first vice-president, Northern Pacific; and John Purcell, assistant to vice-president, Atchison, Topeka & Santa Fe. J. T. Wallis, general superintendent of motive power, Pennsylvania Railroad has also taken part in the conferences.

The locomotive builders' committee, besides Mr. Vauclain, includes Andrew Fletcher, president of the American Locomotive Company, and H. P. Ayres, vice-president of the H. K. Porter Company.

POLICY AS TO LABOR

In a letter to the Regional Directors on February 4 the Director General outlined the labor policy as follows:

"As to labor, you have been advised of the appointment of the Railroad Wage Commission. The general policy as to all labor is that there shall be no interruption of work because of any controversies between employers and employees. All matters relating to wages and living conditions will have the consideration of the Railroad Wage Commission.

"Pending action by me upon the report of that commission there ought not to be any radical change in existing practices without submitting the matter to me for approval. But it should be understood that the usual methods of settling by agreement ordinary grievances and complaints shall continue as heretofore and that the companies are free to negotiate as heretofore with their employees and are expected to observe faithfully existing agreements with their employees. In cases of doubt about new negotiations with employees, the advice of the Director General should be sought.

"You should bear in mind that labor has the very natural feeling that railroad managers, although now working for the government and on government account, necessarily continue the same conception of and attitude towards labor problems that they had when acting under private management. I am told that labor will have a natural suspicion that any unfavorable action taken by railroad managers indicates a purpose on their part to make governmental control a failure and to use it for promotion or vindication of their own theories. For these reasons, great care should be taken to avoid anything having even the appearance of arbitrary action, and it will be expedient, at least at the outset and until the matter shall take more definite shape, not to dispose, unless by mutual agreement, of any labor claims involving large questions of policy without first submitting the matter to me.

"In the central organization in Washington I propose to have a labor man as a member of my staff who will give his special attention to labor problems, not only to the problems of wages and conditions but also to the problem of aiding the railroads in obtaining sufficient labor and of bringing about a better understanding between officers and em-

ployees. The morale and esprit de corps of officers and men should be brought to the highest standards."

GENERAL ORDER NO. 8, GOVERNING LABOR CONDITIONS

To correct numerous misunderstandings that have arisen as to the relations between railroads and their employees, Director General McAdoo has issued in General Order No. 8 a statement outlining his desires as to labor conditions.

The order directs that:

(1) All acts of Congress to promote the safety of employees and travelers upon the railroads, including acts requiring investigation of accidents on railroads, and orders of the Interstate Commerce Commission made in accordance therewith, must be fully complied with. These acts and orders refer to hours of service, safety appliances and inspection. Now that the railroads are in the possession and control of the government, the statement says, it would be futile to impose fines for violations of said laws and orders upon the government; therefore it will become the duty of the Director General in the enforcement of said laws and orders to impose punishments for wilful and inexcusable violations thereof upon the person or persons responsible therefor, such punishment to be determined by the facts in each case.

(2) When the exigencies of the service require it, or when a sufficient number of employees in any department are not available to render the public prompt transportation service, employees will be required to work a reasonable amount of overtime. So far as efficient and economic operation will permit, excessive hours of employment will not be required of employees.

(3) The broad question of wages and hours will be passed upon and reported to the Director General as promptly as possible by the present Railroad Wage Commission. Pending a disposition of these matters by the Director General, all requests of employees involving revisions of schedules or general changes in conditions affecting wages and hours, will be held in abeyance by both the managers and employees. Wages, when determined upon, will be made retroactive to January 1, 1918, and adjusted accordingly. Matters of controversy arising under interpretations of existing wage agreements and other matters not relating to wages and hours will take their usual course, and in the event of inability to reach a settlement will be referred to the Director General.

(4) In order No. 1, issued December 29, 1917, the following appeared:

"All officers, agents and employees of such transportation system *may* continue in the performance of their present regular duties, reporting to the same officers as heretofore and on the same terms of employment."

The impression seems to exist on some railroads, the order says, that the said order was intended to prevent any change in the terms of employment during governmental operation. The purpose of the order was to confirm all terms of employment existing upon that date, but subject to subsequent modifications deemed advisable for the requirements of the service. Any contrary impression or construction is erroneous. Officers and employees will be governed by the construction here given.

(5) No discrimination will be made in the employment, retention, or conditions of employment of the employees because of membership or non-membership in labor organizations.

The order concludes with the following:

"The government now being in control of the railroads, the officers and employees of the various companies no longer serve a private interest. All now serve the government and the public interest only. I want the officers and employees to get the spirit of this new era. Supreme devotion to country, an invincible determination to perform the imperative duties of the hour while the life of the nation is imperilled by war, must obliterate old enmities and make friends and comrades of us all. There must be co-operation, not antagonism; confidence, not suspicion; mutual helpfulness, not grudging performance; just consideration, not arbitrary disregard of each other's rights and feelings; a fine discipline based on mutual respect and sympathy; and an earnest desire to serve the great public faithfully and efficiently. This is the new spirit and purpose that must pervade every part and branch of the National Railroad Service.

"America's safety, America's ideals, America's rights are at stake. Democracy and liberty throughout the world depend upon America's valor, America's strength, America's fighting power. We can win and save the world from despotism and bondage only if we pull together. We cannot pull apart without ditching the train. Let us go forward with unshakable purpose to do our part superlatively. Then we shall save America, restore peace to a distracted world and gain for ourselves the coveted distinction and just reward of patriotic service nobly done."

RAILWAY SHOP EMPLOYEES

Director General McAdoo also announced that the railroad shop employees, realizing the necessity of assisting the government in the operating of the railroads on a more efficient basis and to meet the present emergency in the repairing of locomotives, acting through A. O. Wharton, president, railway employees' department, American Federation of Labor, and the international officers representing the machinists, boilermakers, blacksmiths, carmen, sheet-metal workers, electrical workers, and apprentices and helpers, have agreed to these changes in working conditions:

(1) The hours of labor in shops and roundhouses to be governed by the necessities as indicated by the general condition of equipment. At shops and roundhouses now working one shift which totals less than 70 hours per week, an increase, preferably on a seven-day basis, may be made. Where desired, working hours may be so arranged that men will be released at 4 p. m. on one day each week. Existing working agreements to govern the rate, subject to the action of the Railroad Wage Commission.

(2) All apprentices who have served three years may be promoted to mechanics and paid the going rate of wages for that position. Such promoted apprentices to be given the right of practical experience on work of their respective trades to which they had not been advanced during the three-year period.

(3) Helpers in their respective trades who have had five or more years' experience may be promoted to classification of mechanics; they to receive mechanics' rate and be given an opportunity to learn all branches of the trade. The duly authorized committeeman of each trade in each shop covered by agreement shall be consulted, and mutual understanding arrived at in promoting helpers; and the ratio of helpers to be promoted, to the number of mechanics, in any one trade in any one shop, shall not exceed 20 per cent. The international officers and general chairmen of each trade on each road covered by agreements shall be furnished a complete record of the men promoted.

(4) Mechanics applying for employment will not be denied such employment for any cause other than inability to perform the work; this preference rule to be in effect as long as three-year apprentices or promoted helpers are employed at mechanics' rates.

(5) Where a reduction is made in the force of mechanics, promoted helpers in accordance with their seniority shall be set back first; then advanced apprentices; no mechanics to be laid off until all such promoted helpers and apprentices have been set back.

(6) The promotions above referred to are to meet an emergency caused by the war, and shall cease at the close of the war.

Consolidation Type Locomotive.

LOCOMOTIVES FOR FRENCH RAILWAYS

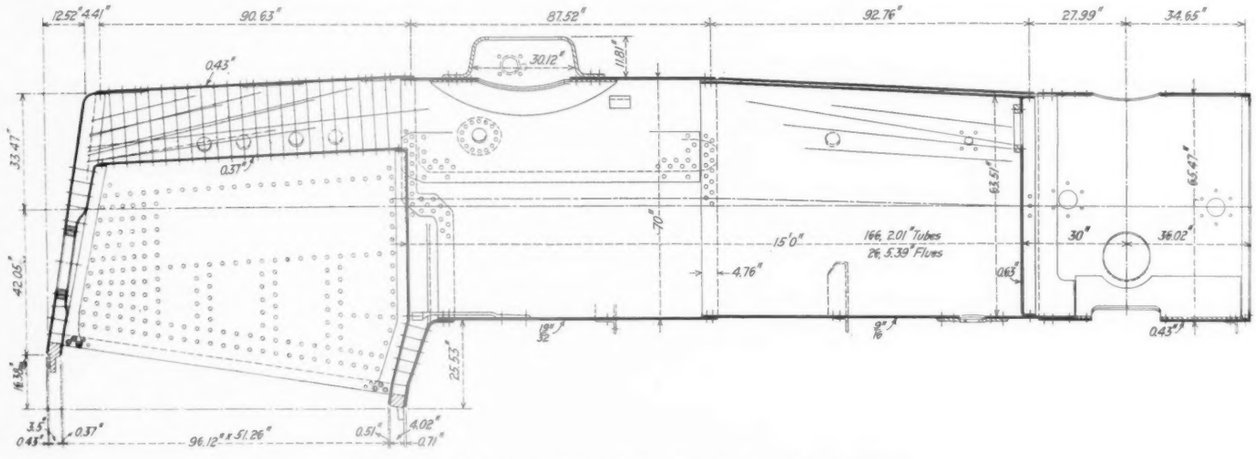
Consolidation Type Engines for Freight Service Built in America from Basic American Designs

TWO orders of consolidated locomotives, aggregating 140 engines, have recently been completed by the American Locomotive Company for France. The Chemins de Fer du Midi received 40 and the French State Railway 100 locomotives, the design being the same in both cases with the exception of the diameter of the driving wheels and some other minor differences.

The engines are of basic American design modified in fittings and fixtures to suit French practice. They were designed by the builder, and each drawing was approved by a representative of the railway. The dimensions are in the metric system, the International system of screw threads, and the French-Westinghouse system of pipe threads.

The locomotives all have cylinders 23 in. by 26 in., and carry 170.6 lb. boiler pressure. Owing to the slight difference in the diameter of the drivers there is a difference of 1,000 lb. in the tractive effort of the two orders, the locomotives for the French State Railway developing a tractive effort of 35,200 lb., while those for the Midi develop 36,200 lb. While the boiler capacity is low in relation to the cylinder capacity, it compares very favorably with recently built locomotives of the same type for use on American railroads.

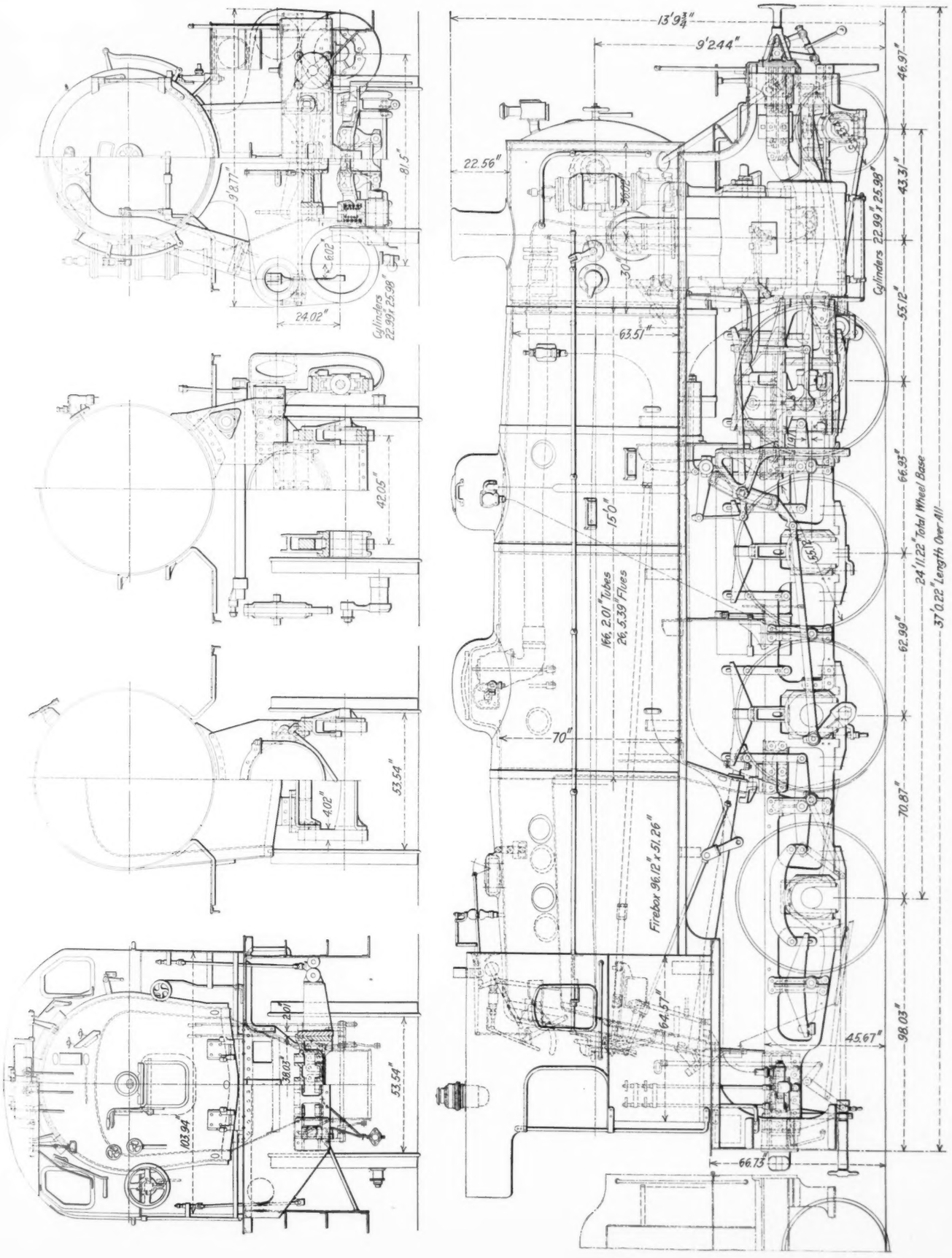
The dimensions of both boilers are identical. The design in general follows American practice, a good grate area being obtained by the use of a short, wide firebox. The firebox is fitted with a brick arch and the boiler includes a 26-element superheater. Handholes are used instead of washout plugs to give greater accessibility for washing out. A dump grate in the front of firebox is operated from the cab by a screw, and the outside end of the blowoff cock has a special thread for connection to the fire hydrants of the city of Paris. In order to quickly free the stack of smoke, the blower is fitted with a quick-opening valve operated from either side of the cab. Lagging on the boiler is omitted; the jacket is supported on a crinoline frame leaving an air space which acts as a non-conductor.



Longitudinal Section of the Boiler for the French Locomotives

The firebox is fitted with an inside opening firedoor to meet the requirements of a French law. The door is hinged at the top and is opened by means of a lever extending upward at one side of the door frame. This lever is fitted with a latch, which operates in a quadrant provided with notches permitting the door to be fastened in wide open, partially open and closed positions. The door opens inward and upward, and when closed hangs at an angle of about 25 deg. from the vertical.

Among the points of general interest in the design, it will be noted that the locomotives for both railroads are



Elevation and Sections of the Chemins de Fer du Midi Locomotive

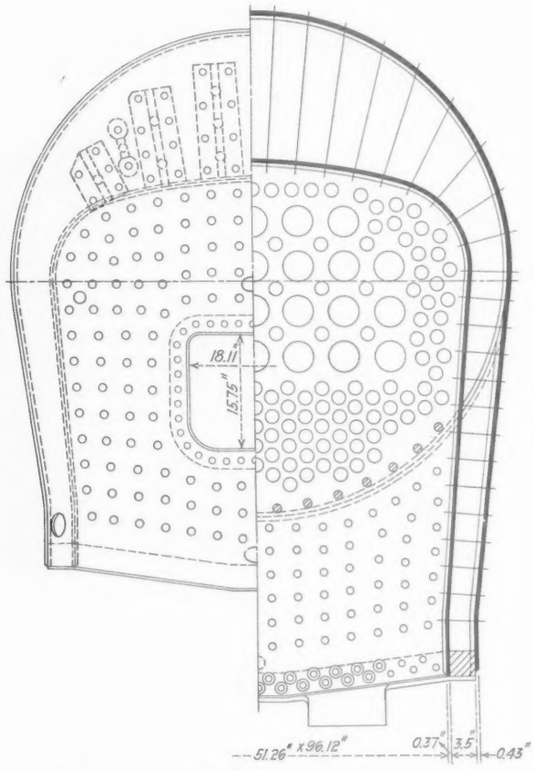
controlled from the left side, contrary to American practice. The steam is distributed by 10¼-in. piston valves, which are controlled by the Walschaert valve gear. The cylinders are fitted with by-pass valves operated by air cylinders, and with muffled cylinder cocks.

All the engines have a variable exhaust operated from the cab by a screw which passes through one of the handrails, and the front ends are fitted with spark arresters.

While the running gear in general is designed along the lines commonly followed in this country, the cross-balancing of the driving wheels is contrary to American practice for two-cylinder locomotives. The effect of this practice on the angularity of the counterbalances is clearly indicated in the illustration of the French State Railway locomotive.

A pneumatic sander is combined with a screw conveyor which extends through the sandbox and is operated from the cab.

Roy buffers are applied between the engine and tender



Back Head and Section Through the Firebox

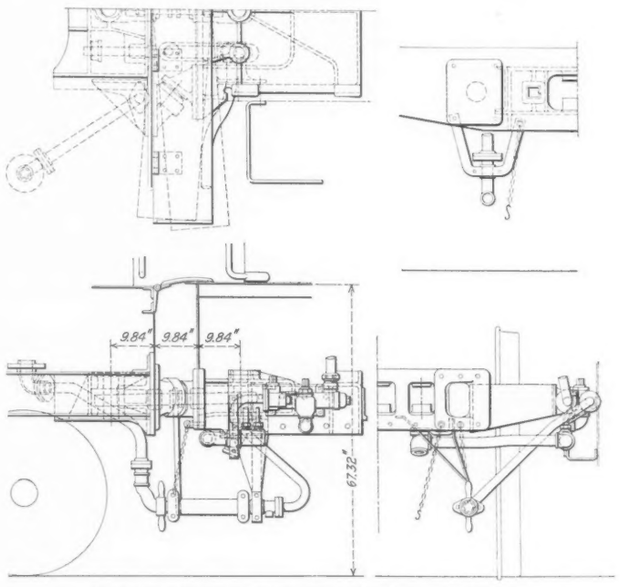
on both orders. The general arrangement of these buffers, together with other details of the engine and tender connections, is shown on one of the drawings. Instead of using one buffer directly over the center line of the drawbar, two buffers are placed one on either side of the center of the locomotive, the angle of the bearing surfaces in each case being arranged so that angular movement between the locomotive and tender causes a sliding movement of the buffers. The center lines of the engine buffers intersect the center line of the locomotive at the center of the drawbar pin hole. The engine and tender drawbar is of the same type that is generally used between cars in Europe. The ends containing the holes for the drawbar pins are threaded to take a right and left hand screw, by means of which the slack between the engine and tender may be taken up.

Other special types of equipment include French Westinghouse air brakes, French standard buffers and couplers and a water brake.

The general dimensions and data for the two locomotives are given in the table:

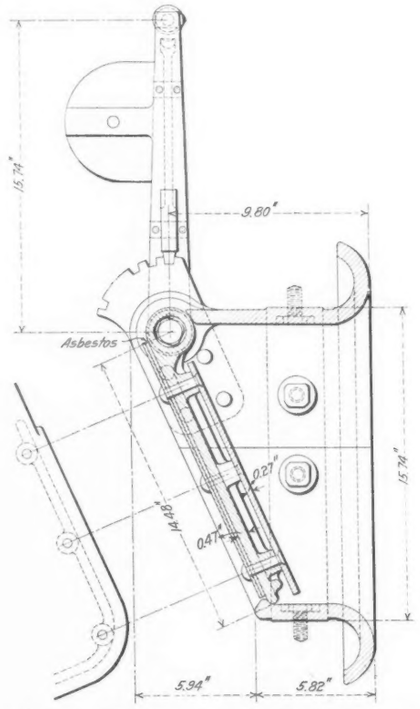
General Data

	French State	Midi
Gage	4 ft. 8½ in.	
Service	Freight	
Fuel	Bit. coal	



Details of the Engine and Tender Connection.

Tractive effort	35,200 lb.	36,200 lb.
Weight in working order	160,000 lb.	159,500 lb.
Weight on drivers	139,000 lb.	138,500 lb.
Weight on leading truck	21,000 lb.	
Weight of engine and tender in working order	266,400 lb.	264,500 lb.



Inside—Opening Fire Door for the French Locomotives.

Wheel base, driving	16 ft. 9 in.
Wheel base, total	24 ft. 11¼ in.
Wheel base, engine and tender	53 ft. 3¼ in.

Ratios

Weight on drivers ÷ tractive effort	4.0	3.9
Total weight ÷ tractive effort	4.6	4.4

Tractive effort × diam. drivers ÷ equivalent heating surface*	748.6	748.5
Equivalent heating surface* ÷ grate area	76.2	
Firebox heating surface ÷ equivalent heating surface,* per cent	5.3	
Weight on drivers ÷ equivalent heating surface*	52.1	52.0
Total weight ÷ equivalent heating surface*	60.0	59.8
Volume both cylinders	12.5 cu. ft.	
Equivalent heating surface* ÷ vol. cylinders	213.2	
Grate area ÷ vol. cylinders	2.7	
Cylinders		
Kind	Simple	
Diameter and stroke	23 in. by 26 in.	
Valves		
Kind	Piston	
Diameter	10¼ in.	
Greatest travel	6 in.	
Outside lap	1 in.	
Inside clearance	Line and line	
Lead in full gear	¼ in.	
Wheels		
Driving, diameter over tires	56¾ in.	55⅛ in.
Driving, thickness of tires	2¾ in.	
Driving journals, main, diameter and length	9 in. by 10 in.	
Driving journals, others, diameters and length	8 in. by 10 in.	
Engine truck wheels, diameter	33½ in.	
Engine truck, journals	5½ in. by 10 in.	

Boiler	
Style	E. W. T.
Working pressure	170.6 lb. per sq. in.
Outside diameter of first ring	64⅝ in.
Firebox, length and width	96⅛ in. by 51¼ in.
Firebox plates, thickness	Crown, sides and back, ⅜ in.; tube, ½ in.
Firebox, water space	Sides and back, 3½ in.; front, 4 in.
Tubes, number and outside diameter	166—2 in.
Flues, number and outside diameter	26—5⅜ in.
Tubes and flues, length	15 ft.
Heating surface, tubes and flues	1,840 sq. ft.
Heating surface, firebox	142 sq. ft.
Heating surface, total	1,982 sq. ft.
Superheater heating surface	456 sq. ft.
Equivalent heating surface*	2,666 sq. ft.
Grate area	34.2 sq. ft.
Tender	
Tank	Water bottom
Frame	Channel
Weight	106,400 lb. 105,000 lb.
Wheels, diameter	37¾ in.
Journals, diameter and length	5⅛ in. by 9½ in.
Water capacity	4,756 gal.
Coal capacity	5 metric tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

CALCULATION OF BOILER STRESSES

A Series of Diagrams Which Will Save Time and Labor in Figuring Strength and Efficiency of Seams

BY G. E. PARKS
Mechanical Engineer, Michigan Central

IN boiler design and the calculation of boiler stresses, systems of curves like those illustrated below have proved of material value in Michigan Central practice. They are not only a great labor saver and aid in checking boiler specification cards, but they will often show at a glance the best possible arrangement of detail or size of part. Their accuracy will depend upon the scale employed.

Fig. 1 shows the relation between the efficiency of the boiler seam and the tensile strength of the plate for various thicknesses of plate and as two systems of curves are represented on a single co-ordinate field, care should be exercised in using the respective scales. The curved lines on the co-ordinate field represent the efficiency of the American Locomotive Company's seam, drawings 142-S-30,080-81-90 (known as seam No. 1), for different tensile strengths of plates. The dimensions of this seam are given in Fig. 2 and the curves are plotted from the equation

$$T = \frac{SA}{t\left(\frac{p}{100} - c\right)}$$

where:

T = Tensile strength of plate in pounds per square inch.
S = Shearing strength of rivets in pounds per square inch, taken as 44,000 lb.
A = Area of rivet hole in square inches.
t = Thickness of sheet in inches.
p = Pitch of outside row of rivets in inches.
E = Efficiency of seam in per cent.
C = The pitch, minus twice the diameter of rivet hole (p—2d), or the length of metal between alternate rivets in the second row.

The straight lines on the co-ordinate field represent the relation between the efficiency of seam No. 1 and the efficiency of the various other seams as plotted. If we assume that the tensile strengths and thickness of plate is the same in each case, the equation for the straight lines becomes

$$E_2 = 100\left\{\frac{A_2p_1}{A_1p_2}E_1 + \frac{A_1C_2 - A_2C_1}{A_1p_2}\right\}$$

In this equation the letters represent the values as given above, the subscript figure "1" representing values in seam No. 1 and the subscript figure "2" representing values in the seam under investigation.

The points marked "X" at the lower end of the straight lines representing seams 15 and 57, also seam 64, indicate the position of the curve at which the efficiency of the seam for shearing all of the rivets and the efficiency of the seam when tearing through the second row of rivets and shearing the rivets in the outside row are equal. Therefore, if the thickness and tensile strength of plate in seams 15, 57 and 64 are such that the point of intersection between the curved line representing the thickness of plate, and the horizontal line representing the tensile strength of plate falls at the left of the point "X," the seam will fail by the shearing of all of the rivets. The efficiency is determined as follows:

From the point of intersection between the curved line representing the thickness of the sheet and the horizontal line representing the tensile strength of the sheet, project a line in a vertical direction until it comes in contact with the straight line, marked "Actual Shearing Efficiency." Opposite this point of intersection, read on the vertical scale the shearing efficiency of the seam. The co-ordinate field as plotted does not show the points where the shear of all of the rivets is equal to the efficiency of seam through the second row of rivets, for seams Nos. 2, 3, 14 and 55, therefore, these seams would not fail due to shear of all of the rivets for any thickness of plate or tensile strength of plate, which is given on the drawing.

The equation of the straight line marked "Actual Shearing Efficiency" is:

$$Es_2 = \frac{A_2N_2}{A_1P_2}(P_1E_1 - C_1)$$

where:

Es_2 = Efficiency due to shear of all of the rivets in seam under investigation represented by the straight line.
A_2 = Area of rivet hole in seam under investigation.
A_1 = Area of rivet hole in seam No. 1, represented by the curved lines.
N_2 = Number of rivet shearing planes of seam under investigation. In all seams plotted on this sheet, N_2 equals 9.
P_2 = Pitch of rivets in outside row of seam under investigation.
P_1 = Pitch of rivets in outside row of seam, No. 1.
E_1 = Efficiency of seam, No. 1.
C_1 = Pitch minus twice diameter of rivet hole in the seam, No. 1.

At a point representing 85.52 per cent efficiency for seam No. 1 is a vertical dotted line which is the efficiency of the

seam through the first row of rivets. If the thickness and tensile strength of plate are such that the efficiency for seam No. 1 is higher than 85.52 per cent and is shown on the right of the dotted line, the higher efficiency should not be considered as the seam would fail through the first row of rivets which has an efficiency of 85.52 per cent. At the right end of the straight lines representing seams No. 2, 3 and 14 are the points where failure will occur in the first row of rivets and these points represent the maximum efficiency of the seams. The co-ordinate field is not large enough to show similar points for seams No. 15, 57 and 64.

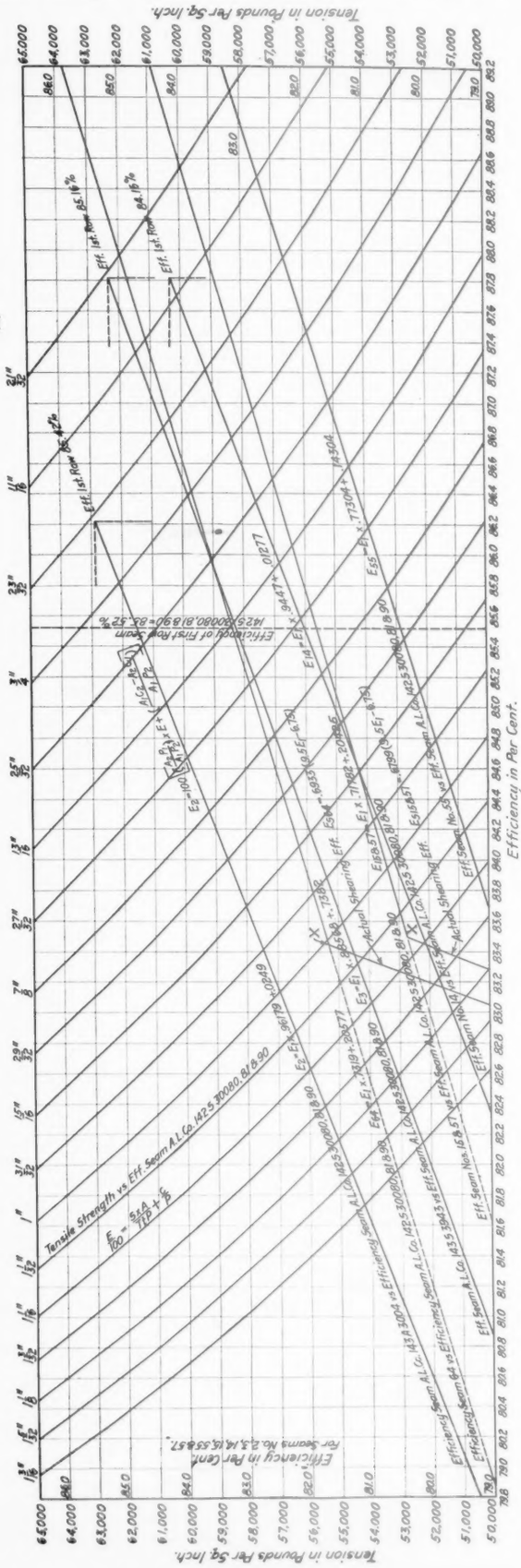

Tension in Pounds Per Sq. Inch.
Efficiency in Per Cent.
Eff. 1st Row 85.1%
Eff. 1st Row 84.1%
Eff. 1st Row 85.42%
Efficiency of First Row Seam = 1425 30080 81 890 = 85.52%
Tensile Strength vs Eff. Seam A.L.Co. 1425 30080 81 890
Efficiency Seam 64 vs Efficiency Seam A.L.Co. 1425 30080 81 890
Efficiency Seam No. 2, 3 & 14 & 15 & 57
Eff. Seam A.L.Co. 1425 30080 81 890
Eff. Seam A.L.Co. 1435 3943 vs Eff. Seam A.L.Co. 1425 30080 81 890
Eff. Seam No. 64 vs Eff. Seam A.L.Co. 1425 30080 81 890
Eff. Seam No. 55
Eff. Seam No. 15 & 57
Eff. Seam No. 14
Eff. Seam No. 1 vs Eff. Seam A.L.Co. 1425 30080 81 890
Eff. Seam No. 53 vs Eff. Seam A.L.Co. 1425 30080 81 890
Eff. Seam No. 3 vs Eff. Seam A.L.Co. 1425 30080 81 890
Eff. Seam No. 2 vs Eff. Seam A.L.Co. 1425 30080 81 890
Efficiency for Seams No. 2, 3, 14, 15 & 57.

Fig. 1—Seam Efficiency for Varying Tensile Strength and Thickness of Plate

Problem 1.—To find the efficiency of boiler seam No. 1 having 1⅛-in. plate, the tensile strength of which is 58,000 lb.

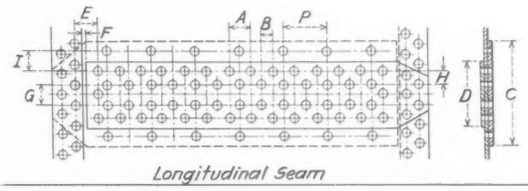
From the point of intersection of the 58,000 lb. line on the horizontal scale and the curve representing a 1⅛-in. plate, project a line vertically either to the top or bottom axis and read off the efficiency, which is 81.6 per cent.

Problem 2.—To find the efficiency of boiler seam No. 2 having 1⅛-in. plate, the tensile strength of which is 58,000 lb.

First find the efficiency that seam No. 1 would have under the same conditions, which is 81.6 per cent. Then from the point where the vertical line representing 81.6 per cent intersects the straight line representing seam No. 2 find the efficiency corresponding to this point on the vertical scale, which is 81 per cent.

This system of curves may be used to determine the value of any of the factors in the general equation when the other factors are known.

Problem 3.—To find the tensile strength required for 15/16-in. plate to give an efficiency of 80.5 per cent, using seam No. 14 as an example.



Longitudinal Seam

Dimensions of Seams

Seam	Diam. Rivet	Diam. Rivet Hole	P	A	B	C	D	E	F	G	H	I
1425 30080 81 90 Seam No. 1	15/16"	1⅜"	9½"	4¾"	2⅜"	19¾"	12¼"	4¾"	¾"	3¾"	2⅜"	3¾"
143 A 3004 Seam No. 2	1¼	1 5/16	9	4½	2¼	18½	11½	4½	¾	3½	2¼	3½
1435 3943 Seam No. 3	1⅛	1 3/16	8	4	2	17	10½	4	¾	3¼	2	3¼
14	1⅛	1 3/16	7½	3¾	1⅞	16¼	10	3¾	¾	2¾	2	3⅛
15 & 57	15/16	1	7	3½	1¾	14¼	8¾	3½	¾	2½	1¾	2¾
55	15/16	1	6½	3¼	1⅝	14¼	8¾	3¼	¾	2½	1¾	2¾
64	1	1 1/16	7¾	3⅞	1 15/16	16¾	10⅝	3⅞	¾	3½	2¼	3½

Fig. 2—Dimensions of Standard Boiler Seams

On the vertical scale of efficiency find 80.5 per cent, and project a line in a horizontal direction until it intersects the line representing seam 14. From this point project vertically to the 15/16-in. line, and this intersection projected to the vertical axis gives a tensile strength of 57,000 lb. per sq. in.

Problem 4.—If seam No. 14 has an efficiency of 80.0 per cent what will be the efficiency of seam No. 2, providing that the thickness of plate, tensile strength of plate and shearing stress of rivets are alike for both seams?

From the point where the 80.0 per cent line from the vertical scale intersects the line of seam No. 14, project a line vertically to the line of seam No. 2 and from this point project a line horizontally and find the efficiency, which is 82.7 per cent.

Fig. 3 shows the stress on several sizes of stay bolts, under conditions varying from supporting 13 sq. in. to 22 sq. in.

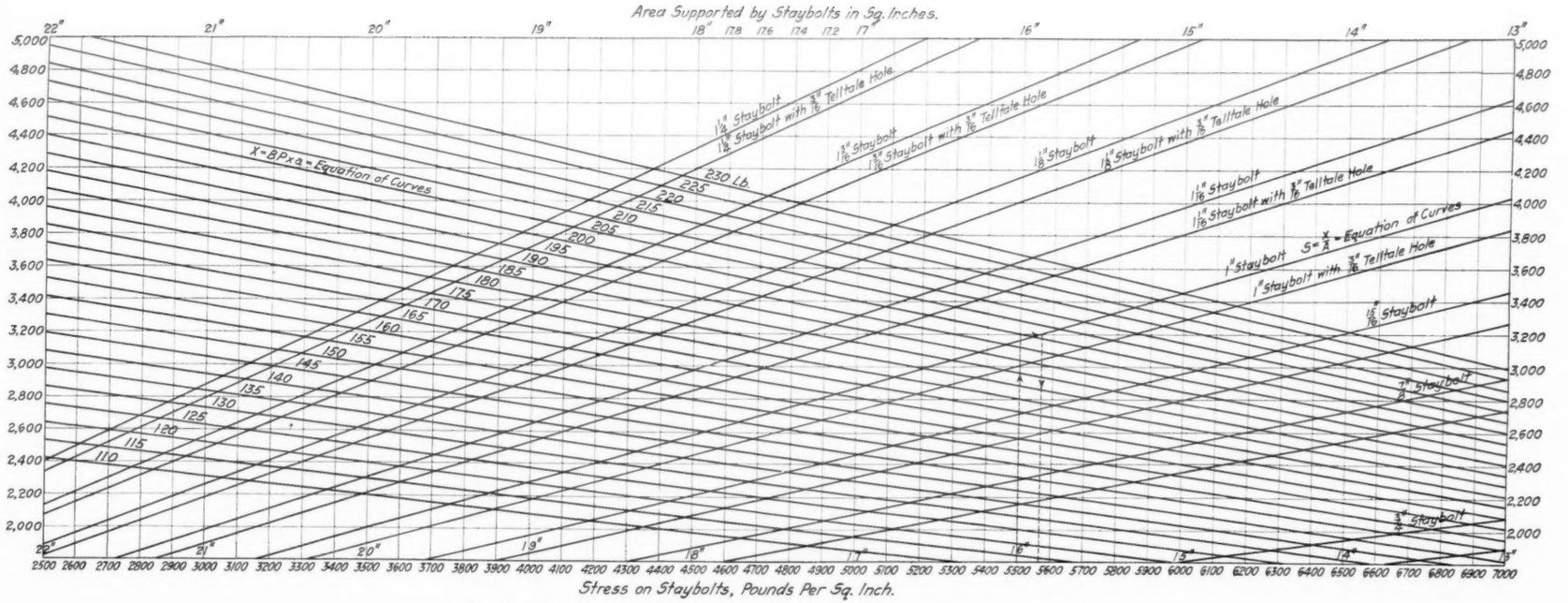

Area Supported by Staybolts in Sq. Inches.
X=BPxa=Equation of Curves
1/2" Staybolt
1/2" Staybolt with 3/16" Telltale Hole
13/16" Staybolt
13/16" Staybolt with 3/16" Telltale Hole
1" Staybolt
1" Staybolt with 3/16" Telltale Hole
1 1/16" Staybolt
1 1/16" Staybolt with 3/16" Telltale Hole
1" Staybolt S=X/A=Equation of Curves
1" Staybolt with 3/16" Telltale Hole
1 5/16" Staybolt
7/8" Staybolt
3/4" Staybolt
Stress on Staybolts, Pounds Per Sq. Inch.

Fig. 3—Staybolt Stress for Varying Boiler Pressure and Supported Area

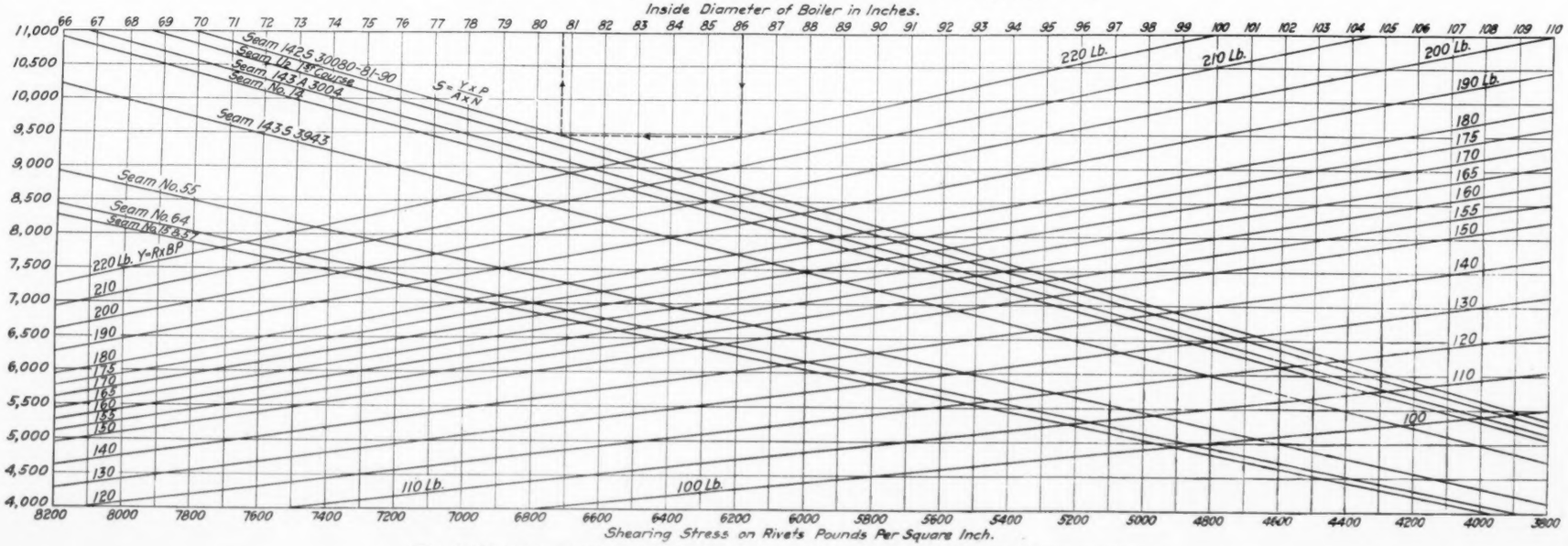


Fig. 4—Shearing Stress on Rivets for Boilers of Varying Diameter and Steam Pressure

of area with boiler pressures varying from 110 lb. to 230 lb. gage, advancing by five pounds each.

The general equation is

$$S = \frac{BP \times a}{A}$$

where:

S = Stress on stay bolt in pounds per square inch.
BP = Boiler pressure in pounds per square inch as shown by gage.
a = Area in square inches supported by stay bolt.
A = Area of stay bolt in square inches.

There are two systems of curves on the co-ordinate field, and care should be exercised in using the respective scales. The lines marked with the boiler pressure show the relation between the boiler pressure and the area supported by the stay bolts and the lines marked with the various sizes of stay bolts show the relation between the product of boiler pressure times area supported and the stress on stay bolts as illustrated. The area for the stay bolts is taken at the root of the thread, for a *V* thread, 12 threads per in., and there are also lines for stay-bolts which have 3/16-in. telltale holes.

To use the curve it is first necessary to determine the number of square inches of flat surface that is to be supported.

Problem 5.—What is the stress on a 1-in. solid stay bolt with *V* thread, 12 threads per inch when supporting 16 sq. in. at 200 lb. pressure?

On the horizontal axis, either at the top or bottom, find the area supported, in this case 16 sq. in., and project a line vertically until it intersects the 200 lb. line. From this point project a line horizontally to the right until it intersects the 1-in. stay bolt line. This intersection projected vertically either to the top or bottom axis gives the stress on the stay bolt, which in this case is 5,560 lb. per sq. in.

Fig. 4. Shows the shearing stress on rivets for such seams as outlined for boilers varying from 66 in. to 110 in. in diameter, and for steam pressures between the limits of 100 lb. and 220 lb. gage pressure.

The general equation for shearing stress on rivets is

$$S = \frac{R \times P \times BP}{A \times N}$$

where:

S = Shearing stress on rivets in pounds per square inch.
R = Radius in inches of inside of boiler shell.
P = Pitch in inches of rivets in the outside row of seam.
BP = Boiler pressure in pounds per square inch as shown by gage.
A = Area in square inches of rivet hole.
N = Number of rivet shearing planes in pitch length taken.

The system of straight lines marked with the boiler pressure, represent the relation between the radius of the boiler and the boiler pressure. These lines are expressed by the equation R × BP = Y, *Y* representing the figures given on the *Y-axis*. The second system of straight lines represents the relation of the characteristics of each individual seam, so far as shearing stress on the rivets is concerned, to the radius of inside of boiler and boiler pressure.

Problem 6.—What is the shearing stress on the rivets of seam No. 1 when used on a boiler 86-in. inside diameter and carrying 220 lb. pressure?

On the top horizontal axis find the diameter of the inside of the boiler, in this case 86 in., and project a line vertically until it intersects the line marked 220 lb. From this point project a line in a horizontal direction until it intersects the line marked with the seam number, in this case seam 142-S-30,080. This intersection projected vertically to the bottom horizontal axis gives the shearing stress on rivets which is 6,730 lb. per sq. in.

Fig. 5 shows the tension on net section for various thicknesses of plate, boiler pressures, efficiency of seams and diameters of boilers.

The general equation is

$$T = \frac{\frac{D}{2} \times BP}{t \times E}$$

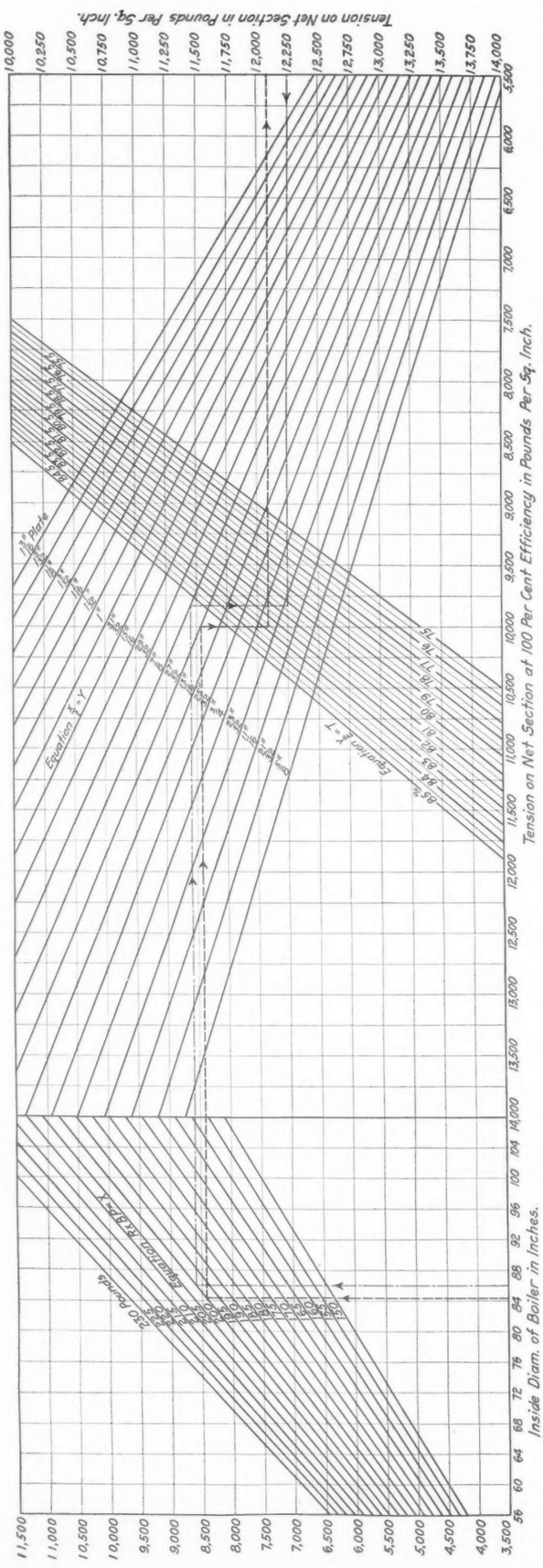


Fig. 5—Tension on Net Section for Varying Boiler Pressure and Diameter, Thickness of Plate and Efficiency of Seam

where:

T = Tension on net section in pounds per square inch.
$\frac{D}{2}$ = Radius in inches of inside of boiler.
BP = Boiler pressure in pounds per square inch as shown on the gage.
t = Thickness of plate in inches.
E = Efficiency of the boiler seam in per cent.

There are two co-ordinate fields shown on the sheet, both of which are used in determining the tension on a net section. One field consists of a series of straight lines showing the relation between boiler pressure and the inside diameter of the boiler. The equation for these lines is

$$X = \frac{D}{2} \times BP$$

where X is equal to the product of boiler pressure and the radius of the inside of the boiler. This is transferred to the second field in obtaining the tension on a net section.

The second field consists of two series of straight lines crossing each other. The series of lines upon which are marked the thicknesses of plate are plotted from the equation

$$Y = \frac{X}{t}$$

where:

Y = Tension on net section at 100 per cent efficiency
t = Thickness of plate in inches.
X = Value of $\frac{D}{2} = BP$ as explained above.

The other series of straight lines upon which are marked the different efficiencies, show the relation between the tension on a net section at 100 per cent efficiency and on a net section for the various other efficiencies of seams as noted. These lines have been plotted from the following equation:

$$T = \frac{Y}{E}$$

where:

T = Tension on net section at the desired efficiency.
E = Efficiency in per cent.
Y = Value of $\frac{X}{t}$ as explained above.

Problem 7.—To find the tension on a net section of a boiler of 84 5/16-in. diameter, 27/32-in. thickness of plate, 200 lb. boiler pressure and 82.75 per cent efficiency of seam.

From the point representing 84 5/16-in. diameter on the horizontal axis of field No. 1, project a line vertically until it intersects the 200 lb. line and from this point project a line horizontally into field No. 2 until it intersects the 27/32-in. line. Project this point vertically until it intersects the line representing 82.5 per cent, where it will be necessary to interpolate to reach an imaginary line representing 82.75 per cent. This point projected horizontally to the vertical axis gives the desired tension on net section as 12,100 lb. per sq. in.

Problem 8.—What efficiency must a boiler seam have when the tension on a net section is 12,250 lb. per sq. in. with inside diameter of the boiler 86 in., boiler pressure 200 lb. and thickness of plate 7/8 in.

From the point representing 86 in. on the horizontal axis of field No. 1, project a line vertically until it intersects the 200 lb. line, and from this point project a line horizontally into field No. 2, until it intersects the 7/8 -in. line. The projection of this point on the horizontal line showing 12,250 lb. tension on a net section gives the required efficiency which is by interpolation 80.2 per cent.

SNOW AND ICE ON THE PENNSYLVANIA

A Story of a Seven Weeks' Struggle During the Worst Winter the Eastern Railroads Ever Experienced

THE months of December, January and February have been truly characterized as the "worst winter" in the history of railroading in the Eastern United States. Seven weeks of arctic weather with fifteen-foot drifts on tracks, below-zero temperatures, and blinding gales that made regular running of trains impossible and at times stopped movement altogether. The experiences of the Pennsylvania Railroad in this seven weeks' struggle with the forces of nature have been brought together in a report by Elisha Lee, acting vice-president in charge of operation, an abstract of which is presented herewith.

Surveying all divisions of the lines east of Pittsburgh the features of the weather during the period covered by the report, were not only the record-breaking cold, the heavy snowfalls and high winds, but the unprecedented length of the frigid spells, which gave no breathing time to recover and prepare for the next emergency. In the mountain regions traversed by the Pennsylvania these conditions were practically unbroken throughout the entire time from mid-December until the beginning of February.

The shopmen stood the acid test of fidelity by shoveling snow, breaking ice and clearing switches, often under weather conditions involving severe hardship. The withdrawal of these men from the shops had a serious effect on repairs and construction, but there was no alternative, as without their aid it would have been impossible to open the lines and restore traffic.

The Altoona shops reported that between December 20 and January 21, their men spent 9,225 ten-hour days in snow-shoveling and switch-clearing. This resulted in the loss to the shops of class repairs to 19 engines, the building of 39 steel freight cars, the strengthening of 33 cars, heavy repairs to 25 others, light repairs to 45 passenger cars and the manufacture of 350 car wheels. In addition, the operation of the shops in general was unavoidably slowed up by the temporary disruption of the forces.

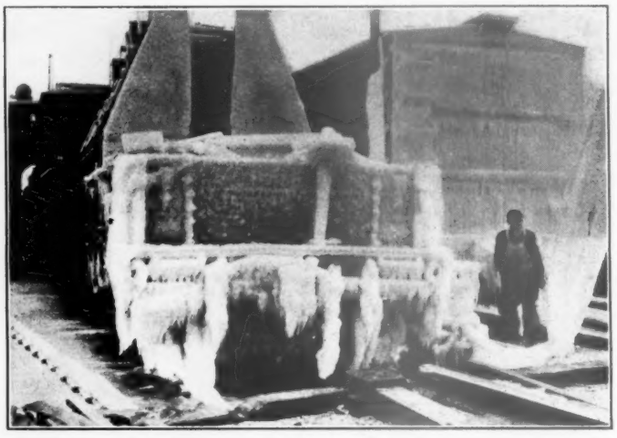
On the Bellwood division, with a shop force of only 259 men, the shopmen spent 11,000 hours in shoveling snow during the same period. This is given in the report as the principal reason for an accumulation of 540 cars awaiting repairs on January 30, the normal capacity of the Bellwood division shops being 150 cars. The Pittsburgh division, for the same reason, reported an accumulation of 2,357 cars awaiting repairs, or 100 per cent above normal.

Showing the disastrous results of a minor accident during severe weather, the Sunbury division reported that during zero weather a truck broke on a freight car east of Boyd, Pa., on the single-track portion of the division. By the time this wreck was cleared, seven following freight trains had frozen up, the crews had to be relieved for rest under the sixteen-hour law, and the cars were stored and the engines towed to the terminal.

Among miscellaneous results reported from the severe cold on all divisions, were air-hose freezing, trains stalling, trains parting due to broken couplings, hot boxes dues to journal boxes being stripped off by snow and ice, broken rails, frozen signals and signal wires, and failure of interlocking plants. Much trouble was experienced with water-

scoops on engines freezing up so that they could not be used. It was frequently necessary to maintain large forces of men at each track tank to remove the accumulation of ice caused by the flying water freezing on the rails and roadway.

The report deals in detail with the effect of extreme cold in lowering the efficiency of unskilled and semi-skilled labor, and in making it impossible in many cases to hold men in the service. On the Cresson division, where conditions were unusually severe, in order to maintain an engine-house force of 149 men, it was necessary to hire 171 new men in four months, making a turnover for that period of nearly



On a Car-float—After a Trip from Norfolk to Cape Charles

115 per cent or at the rate of 344 per cent for the year. The turnover for the entire force of 495 men directly connected with train operations was at the rate of 218 per cent per year.

In the Pittsburgh district the turnover of engine-house forces was at the rate of 192 per cent per year; for firemen and trainmen 120 per cent and for track forces 351 per cent. Furthermore, 55 per cent of the entire force of freight brakemen and 44 per cent of the entire force of firemen on the Pittsburgh division have been in the service less than six months.

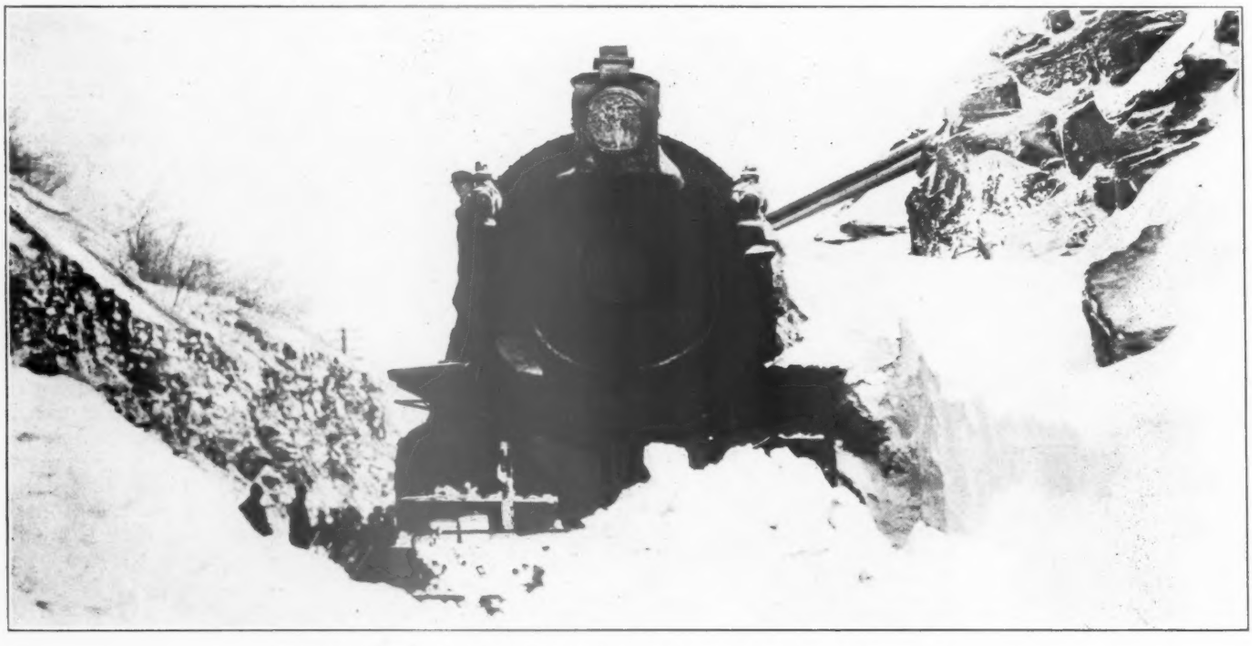
The effect of the weather in reducing the average tonnage carried per freight train was, on the Maryland division, 36 per cent; Philadelphia division, 25 per cent; Middle division, 17 per cent; Pittsburgh division, 38 per cent.

Frozen ash-pans in engines caused thousands of delays

Cut Approaching the Westbound Tunnel near Gallitzin—Drifts 15 ft. Deep

over all portions of the system. Reports on the Cresson and Williamsport divisions show that during zero weather from three to four hours were required to clean one ash-pan, which normally would take from 25 to 40 minutes. The Conemaugh division reported delays due to frozen ash-pans totalling 8,392 hours, which was equivalent to the loss of the services of 35 engines for a month of 30 eight-hour days.

Frozen ash-pans are caused by flying snow, and water dripping from boiler appliances, forming a solid frozen mass with the ashes. Condensed moisture and steam coats the mechanism of the ash-pan so that much time is lost in clearing the working parts, while it is necessary to break



Shop Men Digging Out a Train Stalled on a Branch Line Near Altoona, Pa.

up the solid frozen masses with steam jets and iron bars.

Thousands of delays in the very cold weather were due to the lubrication in the journal boxes of cars freezing, especially where the cars were standing in classification yards. In such cases hot oil had to be used before it was possible to move the cars over the hump. It was often found necessary to push cars down the hump grades because the oil in the axle boxes was so stiffened that they would not run by gravity.

The solidly frozen roadbed, which for weeks at a time was as hard and unyielding as a cement pavement, greatly increased the wear and tear on engines and the amount of repairs required. At the Meadows shop, near Jersey City, from December 30 to January 31, 20 engines arrived at the enginehouse with broken frames, which is a greater number of this class of failures than ordinarily occur in a whole year. Many main and side rods of engines were also broken in the efforts to move cars which had frozen to the rails. The Pittsburgh division reported 576 engine failures in January, 1918, as compared with 398 in January of last year, an increase of 45 per cent. The Conemaugh division reported engines out of service for a total of 4,400 hours in making running repairs, which is equivalent to a loss of 18 engines for a month of 30 eight-hour days.

Much trouble with boilers, especially of engines running in the mountain divisions, was reported from the unavoidable use of water of poor quality, due to the low supply streams, some of which were frozen almost solidly for weeks. This resulted in the failure of thousands of flues and many leaky boilers.

On the night of January 27, when a half dozen through express trains were stalled on the top of the Allegheny mountains near Gallitzin, with the temperature at zero, the wind blowing a gale and the snow drifts in the cuts 12 to 15 feet deep, Train No. 9, the Western Express, with three engines, reached a point half a mile west of Gallitzin, when it was stopped by the snow. The seven rear cars were uncoupled and another engine sent to pull them back, but by the time the tunnel was reached the west portal had drifted shut and it was impossible to go any further. The passengers were taken out of the train and sent to a hotel. It was impossible to move these cars until five o'clock the next afternoon, and then five heavy freight engines were required to pull the seven empty coaches.

Meanwhile the other three cars, together with the three engines which were pulling the train when it stalled, remained a mile and a quarter further on in the drift. Five hundred men worked all the night of January 27 and until the next afternoon, before these three cars and engines were dug out and the track cleared for them to move.

These results, in the face of unprecedented difficulties, were only accomplished by the self-sacrifice, loyalty and devotion to duty of many thousands of officers and employees who cheerfully performed unaccustomed and arduous work and repeatedly faced hardship, danger and real suffering, in the struggle to keep the lines open so that the public and the government might be served.

SUPPLY INTERESTS WRITE MR. MCADOO

An Open Letter to the Director General from the Railway Business Association on Standardization

GEORGE A. POST, president of the Railway Business Association, under date of February 25, sent the following communication to Director General of Railroads McAdoo:

Manufacturers of railway necessaries respectfully invite you to study certain considerations bearing upon mechanical design and practice in the field of rolling stock construction, purchase and maintenance.

The Railway Business Association, of which I have the honor to be president, is a national organization of manufacturers, merchants and engineers dealing with steam railroads. What we have to say from our own experience accurately portrays the problems of the whole railway appliance industry.

It appears from your official announcement that you have delegated to technical committees the work of recommending to you a detailed plan of procedure for the acquirement of new rolling stock by the railroad systems. The phases upon which we desire to address you are those which involve the peculiar interest of makers of appliances or parts as distinguished from assemblers of locomotives and cars.

In the field of transportation inventors and developers of special appliances embody the spirit and function of progress. Our interest and the national interest in this respect are identical. What the manufacturers of railway appliances cherish and what the public as a whole is interested in preserving is that flexibility which leaves the way open to mechanical advance. Always we have before us two antagonistic requirements which must be compromised—improvement through change and stability through standardization.

To a certain extent standardization is essential. As transportation became national and interchange of cars among the several roads became common, convenience and economy in repairs required a tendency toward interchangeability of parts. With the organization of the Railroads' War Board last April came for the first time to any extent use of engines on the rails of roads other than the owner. What has long applied to cars affecting repairs now applies in some degree to engines. The drift, as with cars, is toward interchangeability of parts. The method by which inter-line use of cars was made possible was, to be sure, standardization, but it was a standardization of dimensions. If the car frame were uniform a device of any patent could be used upon it. Thus we attained practical current convenience while preserving variety of design and material, of terms, delivery and dealings, and hence reasonable expedition in the demonstration and introduction of improvements.

We earnestly commend to your favorable consideration the fullest adherence to this method consistent with the most effective rehabilitation and maintenance of transportation facilities in face of the enemy. We are ready for any sacrifice essential to winning the war. We would deplore as disastrous to the nation's business any departure, not clearly necessary for national defense, from competition between patented railway appliances.

Manufacturers of railway goods have borne an honorable part in promoting the progress of transportation science. What they have achieved for the public in safety, comfort, speed and economy of railway operation has been accomplished in an atmosphere of keenest competition. We could try persuasion upon one independent railway manager after another until the test was made and a demonstration afforded. Our work has been marked by variety, elasticity, development. The inventor, the executive and the salesman have been in-

spired by the hope of excelling, roused to effort by the exertions of rivals. Under such conditions our industries and the country with them have progressed and thriven. The man with whom we have hitherto dealt has had a definite responsibility for affording his company the benefit of the latest scientific discoveries.

We believe that the preservation of decentralization in our dealings is not only important for the immediate present, but vital as a precedent for the ultimate adjustment after the war.

Looking especially to the present, many of those engaged in the railway supply industry are profoundly anxious concerning the policy which you will adopt as it may affect them and the scores of thousands of workers whom they employ.

Unofficial statements and rumors have hinted at the possibility of far-reaching standardization, under which large numbers of plants would be swept out of existence or forced to reorganize for some other type of service. A maker produces, let us say, a device which is part of a car. He is one of several who manufacture competing appliances that perform the same function. Will some one of us, he has been asking, be declared standard and all the others thrown into the discard? If so, the conclusion of peace would find the unfortunates whose products had been discarded under the edict of standardization for the period of the war deprived of a large part of the value of their patents through disuse and their business paralyzed through discontinuance of the mechanical and commercial processes which keep any business a progressive living organism.

Established commercial processes are the result of experience and of scrutiny under government regulation, federal and state. We are confident that you will be alert to the desirability of performing your difficult and vital function as Director General of Railroads with the least possible disturbance to those processes. We believe that you will find it practicable to preserve the business and the individuality of the several makers of rolling stock appliances. Cars have now been so far standardized in dimensions that they can travel over any railroad in the United States, as anyone can see who observes upon a freight train the multiplicity of ownership insignia. So far as speed of production is concerned little or no delay is occasioned in changing from one patent to another and substituting on each lot the appliances which have been designated by the particular buyer.

We can see no obstacle to the adoption of a plan under which, whatever the design of the car as a whole, every reputable established appliance for each function would be sanctioned and the several roads directed to exercise, as in the past, their judgment in specifying devices.

What applies to construction of new rolling stock is of more importance in the field of maintaining rolling stock that exists. The largest number of locomotives ever ordered for domestic account in any one year was 6,265. The number of locomotives in use and under maintenance according to the last report was 63,862. The largest number of freight cars ever ordered in any one year was 341,315. The number of freight cars in existence and requiring upkeep as last reported was 2,326,987. Obviously the big end of the rolling stock task and the preponderant consumption of engine and car parts is not in new construction but in maintenance. Apart from repairs made by one railroad upon cars found out of order on its rails a highly important proportion of such work is the thorough overhauling of cars by the road that owns them in its own shops. For replacement of parts broken or worn out each road orders from the makers quantities of whatever appliances are standard upon that road. Stability in the industry during the war will be promoted by permitting in general each road to determine as in the past which of the competing appliances it will use in repairs.

Such a policy, affecting both construction and repair upkeep, will not only give rapidity and certainty to the exigent performance in war and preserve for the time of peace the commercial organizations which have carried on mechanical progress, but it will involve the minimum readjustment of shop operation and production quotas, thus keeping these enterprises in a strong position as payers of war taxes and subscribers to war bonds—these and the tradesmen and the people of the communities wherein their plants are located who draw sustenance primarily from the industrial pay roll.

Please permit me personally, and I believe I may say the same thing in my representative capacity, to felicitate you, Sir, upon your manifest determination to form judgments based upon knowledge and upon the opinion of those whose vocation fits them to serve the country through you at this crisis.

HONEYCOMB

Honeycomb, or flue sheet clinker, is due primarily to the presence in the coal of iron and sulphur impurities known as iron pyrites, or brasses. Contributing causes are lack of air in the firebox and insufficient time for the complete burning or oxidization of these impurities.

Eastern coal contains from 1 to 3 per cent, and Western coal as much as 10 to 12 per cent of this iron and sulphur mixture. Screenings and the finer parts of run-of-mine coal contain more of this substance than lump coal, and honeycomb trouble is most prolific when firing finely crushed coal.

When coal is thrown into the firebox the draft catches up the finer particles, and, if burned at all, they are burned in suspension while whirling through the firebox. If iron pyrites is present, it is decomposed by the heat at a temperature of 900 deg. F., giving off part of its sulphur and leaving a residue known as ferrous sulphide.

If this ferrous sulphide is brought into contact with sufficient oxygen and has time to burn completely, an infusible ash results; but if the oxygen supply is deficient, or the time available is not sufficient, a highly fusible substance known as ferrous oxide is formed. This is driven against the flue sheet in a pasty condition and sticks there. The building up of a slag on the flue sheet is accelerated by the fine particles of cinder and ash, which strike the sticky mass and adhere. It is then only a question of time until the clinker covers sufficient flues to cause a steam failure.

When the clinker first forms, it still contains some sulphur. Under the influence of the high firebox temperature, this sulphur volatilizes and, bubbling out as a gas, causes the "honeycomb" appearance which is responsible for its name.

It is impossible for most railroads to pick and choose coal that does not contain clinker-forming impurities. They must use the coal that is on or adjacent to their lines, regardless of its defects. If it contains honeycomb-forming impurities, it must be burned in such a manner as to overcome this difficulty.

Ample air supply must be maintained in the firebox. Large grate area is needed in order that the rate of combustion be kept low and the draft light. Thin fires and large nozzles should be used. All of the coal possible should be burned on the grates. Large air openings should be provided through the ashpan and grates.

Arches should be used to hold down and deflect the fine particles of coal and dust until they ignite and burn. These particles of coal and clinker-forming impurities must be thoroughly mixed with air and given time to burn. The arch forces this mixing to take place and gives a longer flameway and higher temperature to facilitate the burning. Combustion chambers are also necessary; and when used with the arch and sufficient air supply, will do much to eliminate honeycomb troubles.—*J. T. Anthony in the Erie Railroad Magazine.*

DEVELOPMENT OF THE STEEL CAR*

BY HENRY P. HOFFSTOT
Manager of Sales, Central District, Pressed Steel Car Company

A good many years ago some few all-steel cars were built and placed in operation by some of the steel companies and these cars are, I believe, still in service. The change from the use of wood to steel in the construction of coal cars in America was not brought about at one time but was extremely gradual in its development. In the early 90's C. T. Schoen commenced making pressed steel car shapes in his little plant in lower Allegheny and for years supplied the railroads with pressed steel center plates, side bearings, stake pockets, push pole pockets, etc., for use in connection with the construction of wooden cars. During the same time the Fox plant out on Penn avenue was furnishing pressed steel trucks and truck specialties to railroads for use on wooden equipment.

About 1895 Mr. Schoen conceived the idea of building steel cars on a large scale. The following year the first steel cars were ordered by the Pittsburgh, Bessemer & Lake Erie, and shortly after by the Pittsburgh & Western, and the Pittsburgh & Lake Erie. It is therefore to the foresight of the officers of these three companies that a great deal of the credit for the bringing about of the change from wood, or wooden cars with steel trucks and a few steel specialties to the all-steel car must be given. Mr. Schoen conceived the plan but in order to show the public it was necessary to find a buyer on whose railroad a demonstration of the cars in actual operation could be made. The heads of these three companies took the chance, and that they made no mistake in their judgment is now well recognized. The demand for this type of car grew rapidly. Its construction virtually revolutionized railroad traffic of this country. The first hopper cars were built to carry coal, and while stenciled 50-ton were hardly of 40-ton capacity so far as present M. C. B. requirements are concerned. Probably 85 to 90 per cent of these cars are still running after 20 years of service in and out of the Pittsburgh district, which with its bituminous coal and ore gives the car as severe service as could be received by them anywhere in this country. Since that time there has been an evolution in the construction of cars as great as that which took place in 1896 and 1897.

The railroads are continually demanding cars of heavier capacity so that the increasing volume of tonnage offered can more economically be handled on our congested railroads. Early in this century the combination of pressed steel and structural steel was used in car construction, and this is the type of construction most commonly used today. I am not here to discuss the benefits to be derived from the use of pressed steel over structural steel, or vice versa. Car companies are in the business of supplying a commodity to railroads and industrial concerns the same as a tailor is in the business to sell clothes to his customer. We sell what the customer wants.

There are steel cars and steel cars—some no better than wooden cars which will last under the treatment now given to cars hardly as long as would good wooden cars—and there are steel cars the life of which as yet cannot be computed. Often an additional ton of steel carefully applied in the designing of the steel car will make the car so much stronger and better able to withhold the shocks and wear and tear received in unfair treatment to which we must expect a car to be subjected in the ordinary course of its life that by the end of 12 to 15 years it can be renovated at a comparatively small expense, while the car of poor design has long since undergone heavy repairs and may again be ready for more. In making this comparison it must be assumed that each type of car has undergone the same general treatment and been kept up in the way of painting and minor repairs in about an equal way. I make mention of this comparison not with the idea of passing along the blame for the failure of a particular type of car to the superintendent of motive power or mechanical engineer of the railroad involved who may have originally designed it, for I realize that in all probability it was the financial limitations of the railroad which limited him in the amount to be expended and that it was to keep within such limitations that he failed to authorize the use of the ton of additional steel which if put into the car at the beginning at an additional initial cost of possibly $40 per car might have saved $400 in rehabilitating the car later on.

100-TON CARS

Now the 70-ton car has come into general use, and several thousand 90-ton cars are in operation on at least one well known railroad which is also experimenting with a 100-ton car. The carrying of this huge tonnage has been made possible only through the use of steel in car construction. Heavier bridges, heavier rails, and heavier locomotives, etc., have all been required and are being put in to enable all roads to carry these heavier cars which have done so much toward reducing the cost per ton mile for handling materials and eliminating more or less of the congestion in our large terminals, for if the 30 and 40-ton cars of 20 years were still in operation, it would be necessary in order to carry the same tonnage to have trains anywhere from 20 to 30 per cent greater in length.

Many 100-ton coal cars are now in operation on short lines about the steel mills, and recently one of the railroads became interested in a 120-ton car. Its officers felt that the concentration of a 120-ton load in one car would not only shorten up the trains, thereby making a less number of units for a given train, but also a less number of operations in the dumping machines at the terminals, and would also reduce the number of wearing parts to be maintained as well as eliminate to a great extent the extra long sidings which would otherwise be required to handle the same tonnage in cars of lighter capacity. In other words, some of the general reasons which brought about the change from the 30 to 40-ton capacity wooden cars to 40 and 50-ton steel cars are now tending to bring about the use of very much heavier capacity steel cars. The officers of this particular railroad, fearful lest a mistake might be made in the ordering at the present time of a large number of cars in

*Presented before the Traffic Club of Pittsburgh.

which such a radical change would be made, elected to have four of the large car companies each build a sample car. The engineers of the railroad at that time supplied the car companies with the maximum height and width and approximate length which they felt would carry the required tonnage and left the details of the design of the cars to each of the car companies, their idea being to get these sample cars into actual service, and if experience showed that cars of 120-ton capacity could be more economically used than 50 or 70-ton cars, they would undoubtedly pick out the superior qualities from each of the four sample cars and design a car which in the opinion of their engineers would show as nearly as possible 100 per cent efficiency. These four cars have all been delivered, and are now receiving their trial, and it will be interesting to know the results. I believe that you will agree that this is a good way to get results.

THE STANDARD CAR

All of the car companies employ designing engineers who are at the top of their profession, and while I cannot speak for all of the companies, I can at least speak for the company which I represent and say that we at all times solicit an opportunity to help in the designing of steel and composite cars with a view not of exploiting any particular specialty or type of car, but solely with the view of bettering the steel car, always having in mind that the adoption of a car of standard design for the different classes will mean millions of dollars saved annually in the money expended by the railroads and indirectly by the American public in the first cost of cars and their maintenance. Certain rulings of the M. C. B. Association in the construction of all cars make it necessary to comply with certain regulations so far as clearances, strength, etc., are concerned. These rulings, however, do not go very far toward bringing about standard designs of cars. For many years this question has received more or less attention, and three or four years ago a committee of five builders was appointed by the railroad presidents representing the American Railway Association to go into the matter very carefully. Later ten or twelve railroad representatives were placed on this committee. After three years of labor they made their report and submitted specifications and blueprints covering box cars and gondola cars of several capacities. Shortly after this the committee was dissolved and the work I believe is now being continued in the hands of another committee appointed by the railroad presidents consisting entirely of railroad engineers. It will be interesting to watch the developments along this line, for it is the opinion of many that the greatest advance that can be made in steel car construction at this time will come with the adoption of cars of standard design for use all over the country.

No further progress along these lines can, however, be expected until Congress decides whether the railroads after the war are to remain the property of and be operated by their real owners under the control of an Interstate Commerce Commission, more liberal than heretofore in its views as to rates, or whether permanent government ownership and operation is to prevail.

Car companies are now in position to take orders and commence delivering cars within three months. If the conditions of this winter are not to be repeated next winter, hundreds of locomotives and thousands of cars must be ordered by some one for use on our American railroads to take care of replacements if nothing else. Let Congress act, then watch the 70-ton steel car develop.

Steam Locomotive Exports.—During the month of December, 1917, says a recently issued bulletin of the National City Bank, locomotives were exported from the port of New York having a value of $873,377.

IMPROVE THE CONDITION OF CARS

BY A SUPERINTENDENT OF MOTIVE POWER

There are thousands of cars built in the last few years which are of adequate strength and on which the appliances, such as truck frames, release riggings, draft gears, doors, roofs and ends are designed to meet present day requirements. Such cars are very seldom found on the repair tracks, and are giving excellent service. Freight car interchange will never reach the proper efficiency until minimum standards, covering these items, are prescribed and enforced, to prevent any railroads from building equipment which does not measure up to present day standards. I do not refer to detailed standards, but to standards of strength or operation. All of the above is but working for the protection of the future.

For the present, the following are some of the things which can be done:

One: Apply steel draft arms or steel underframes to wooden underframe cars when they receive general overhauling.

Two: Discontinue the maintenance of short door hasp fasteners, because these are a constant cause of tearing off the front edge of the door, and sending the car to the repair track. This has been known for years, and yet railroads keep right on applying the short fasteners.

Three: Sheathing is frequently re-nailed to decayed sills, which is a waste of time, and if a flat strip of iron or a light angle is applied outside of the sheathing and bolted through the sill, the repairs will be permanent. It is a general practice to use 2½-in. nails for nailing sheathing to side sills, and I believe much better results would be obtained by using 3-in. nails.

Four: There are thousands of cars running with bottom door guides which lap the door only about 1 in. and without any metal protection on the bottom edge of the door. Such doors are a constant source of trouble, on account of coming out of the guides, and such cars should have deeper guides, and a metal edge on the bottom of the door.

Five: Frequently new box car doors are applied, which either rub against the end of the floor boards, or against the track, or hang down on the bottom guides, so that it is impossible to move the doors without the use of a bar. It is a waste of time to do such work, as the new door will simply be torn to pieces by the efforts to move it.

Six: Draft timbers and sill splices are applied which do not abut tightly at the ends.

Seven: End posts are applied which have the bottom corners chamfered off to get them into the pockets, and when the load goes up hard against the end of the car, these posts jump out of the pockets.

The above are only a few samples of poor work which is being done apparently at many of the car repair points in this country, and I doubt whether any railroad has a clean bill of health.

This is done in the effort to get the cars in service, but in my opinion, the ultimate purpose would be better served, by general effort to eliminate the above poor practices, and I think in a very few months the effect would be felt.

Each road dislikes to be the only road to start such a practice, as in some cases it means to hold a car longer to do a good job than it would be necessary to cobble it up, but in the first case the repairs are permanent, and in the second case, the car goes a few miles and then goes on the repair track again, often times on the same road which made the defective repairs in the first place.

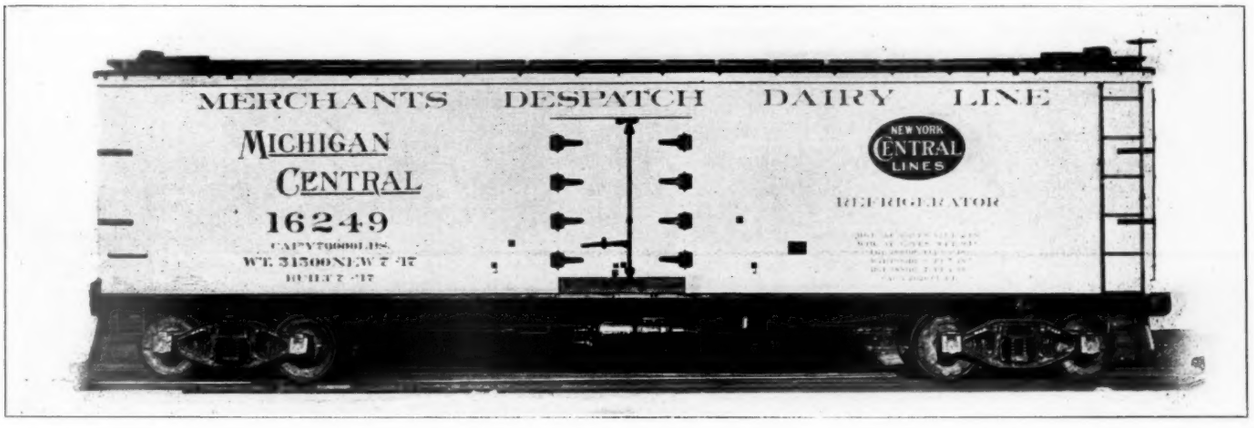
Outside of a better quality of work, in order to make the repairs more permanent, the only other thing that I know of is, for the owning roads to strengthen the weak parts of their cars systematically whenever they have opportunity.

MICHIGAN CENTRAL REFRIGERATOR CAR

Particular Attention Has Been Given the Insulation; Free Circulation of Air in the Bunkers and Floor Permitted

A SHORT time ago the Michigan Central received 250 refrigerator cars which represent the latest development in the construction of this class of equipment. These cars were built by the Merchants Despatch Transportation Company at East Rochester, N. Y. They are 41 feet long and weigh 51,500 pounds, having a rated capacity of 70,000 pounds.

These cars are particularly well insulated, slab cork being used in the floors and below the sub-belt rail on the sides and ends. The sides are insulated with four layers of ½-in. insulation and the ceiling has five layers, the layers being applied with no air space between them. The method of insulating these cars was adopted after making extensive tests with the different methods of application. It was applied so as to eliminate as much as possible all dead air spaces. It has been found difficult to maintain a tight car with the courses of insulation separated, as the constant weaving of the car causes a circulation of air in the supposed dead air space. By placing the various courses of insulation close together, the construction of the car is simplified and the insulation can be supported better. The ice tanks are of M. D. T. standard construction, which was adopted a few years ago. The ice is held in wire screens in the inside of the tank. An air space of 2 in. is left between this screen and the walls of the tank on all sides, which permits free circulation of air around the ice and through the tanks to the base. An insulated bulkhead is used to prevent cooling of the perishable freight near the bulkhead to a lower temperature than is obtained in other parts of the car. Floor racks are provided to allow free circulation of the air under the lading.



Refrigerator Car for the Michigan Central

UNDERFRAME AND SIDE FRAMING

These cars are provided with the Bettendorf steel underframe, which is 41 ft. 4¾ in. over end sills. This underframe supports two side sills and six intermediate sills 5½ in. wide by 4 in. thick. The end sills are of oak, being 6 in. wide by 4 in. thick. The side posts, end posts and diagonal braces are all 4¼ in. by 2 in. Three-quarter inch diagonal rods criss-cross the diagonal braces, as indicated in the drawings. The belt rails and cripples are made of the same material as the posts and braces. The side plates are 6⅞ in. wide by 4⅛ in. thick. The end plates are 12½ in. wide by 4⅞ in. thick, and they extend from inside to inside of the side plates. Both the side and end plates and the side and end sills are mortised to receive the side posts and carlines.

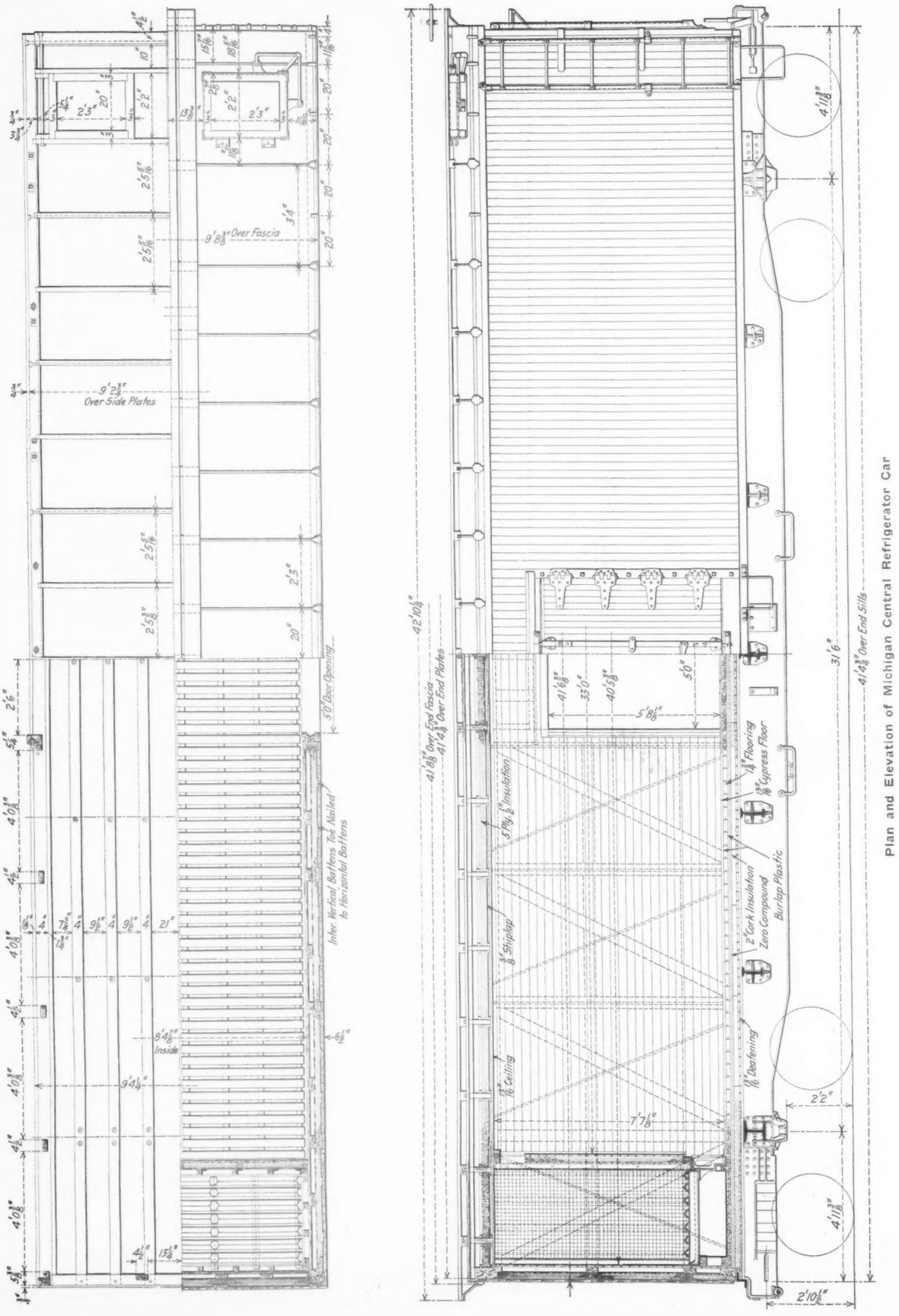
The siding and the inside lining are 13/16 in. thick, and the flooring is 1¾ in. thick. Before applying the floor, the side framing is lined with a special waterproofing which extends from the inside face of the corner post to the door post and over the side sills at the door opening. This extends 16 in. up on the side framing. A layer of burlap plastic is then laid over the sills of the car and extends up 6 in. on the sides. Another layer of burlap plastic is laid over the 1¾-in. flooring, extending up 6 in. on the car framing, and on top of this is placed the top course of flooring which is 13-16 in. thick.

The carlines are mortised into the side plates and are held in position by ½-in. tie rods, extending between the side plates and set flush with the face of the carline. The XLA outside metal roof, made by the Standard Railway Equipment Company, is used on these cars. The roof boards and the ceiling are 13-16 in. thick.

INSULATION

The insulation in the floor is made up of 2-in. corkboard laid on a 13-16-in. false floor between the sills. The cork is held in place by 1-in. nailing strips. Zero compound is then placed over the cork, making a perfect seal.

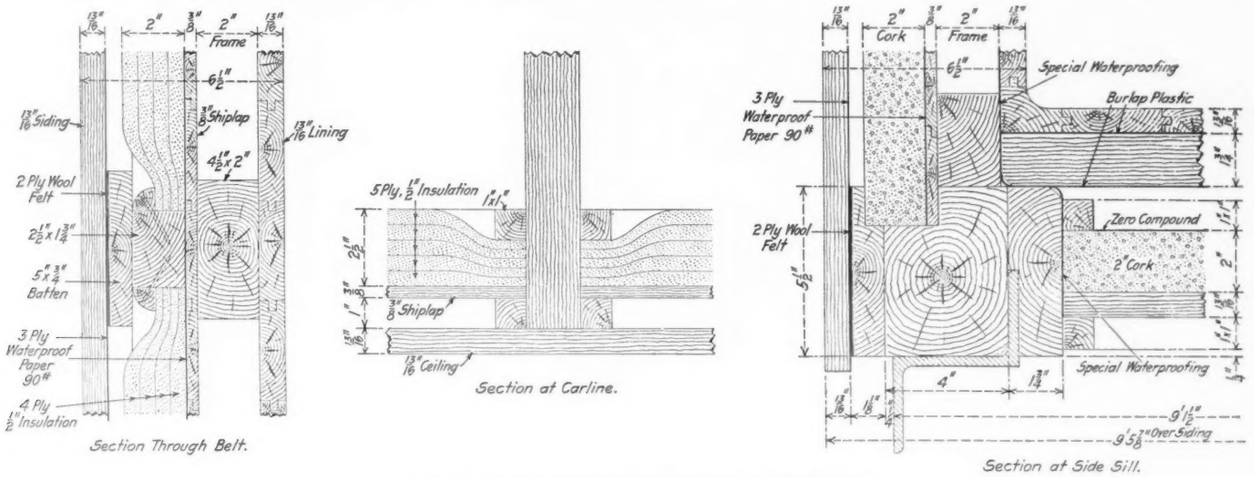
The outside of the car framing is covered with a layer of ⅜-in. shiplap pine. Over this is applied a layer of three-ply 90-lb. waterproof paper extending from side sill to side plate. Sub-belt rails 2½ in. by 1¾ in. are then applied over the belt rails. Between the lower sub-belt rail and the side sill 2-in. corkboard is applied, the faces of the board being dipped in hot Hydrex compound before being applied. The four-ply, ½-in. insulation is applied en masse between the belt rails and the side plates. The insulation is held in place by ¼-in. round nailing strips. Battens are placed at each intermediate post, corner post, door post and belt rails and an additional batten is applied in each panel formed by the vertical battens, belt rails and side plate filler to more securely support the insulation. Two-ply wool felt is applied immediately on top of the battens, and on top of this is applied a layer of three-ply, 90-lb. waterproof paper extending from the top of the side plate to the bottom of the side



Plan and Elevation of Michigan Central Refrigerator Car

sill and from door post to door post around the ends of the car. The siding is applied on top of this.

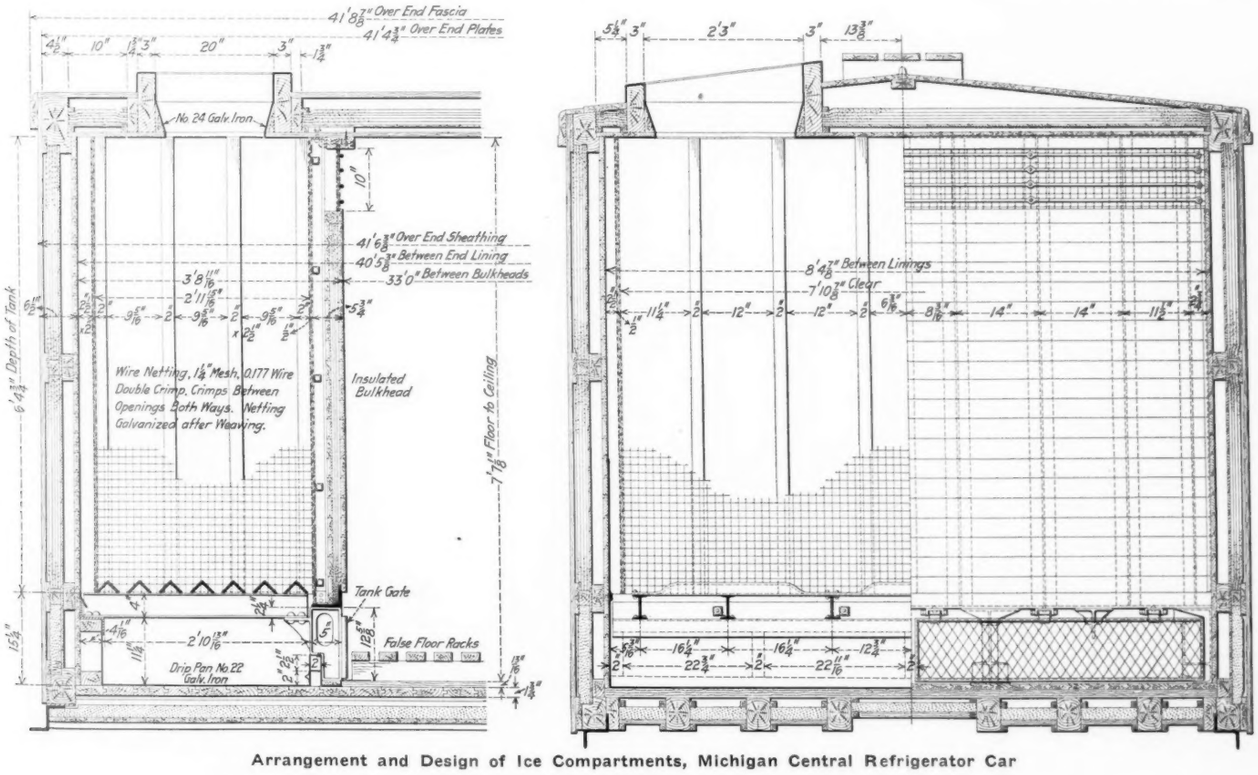
The roof of the car is insulated with five layers of ½-in. insulation applied to a ⅜-in. false ceiling, separated from the ceiling by 1-in. by 1-in. nailing strips. This insulation is held in place by 1-in. by 1-in. nailing strips, as indicated in the illustrations. A layer of burlap plastic is applied between the metal roof and the roof boards.



Various Sections Showing Application of Insulation

ICE COMPARTMENTS

The ice compartments are 3 ft. long by 7 ft. 11 in. wide. The sides and ends of the car are lined with No. 24 galvanized iron to a height of 30 in. The ice grate frame is made up of malleable iron and commercial shapes. There are six 4-in., 7.5-lb. galvanized I-beam supports for the grate bars which rest on a 1 1-16-in., 10 3-10-lb. Z-bar at the rear and the malleable iron casting at the front. The ice grates are 2¾ in. by 2¾ in. by ¼ in. galvanized angles set with the corner up, as indicated in the drawings. The bulkhead is supported on a galvanized 5-in. by 3½-in. by ⅜-in. angle, which is bolted to the malleable base casting. There are eight bulkhead posts of 2-in. by 2-in. by ¼-in. galvanized angles, which are riveted to the bulkhead base at the bottom and bolted to a reinforcing angle through the ceiling at the top. To the intermediate bulkhead posts are bolted 2-in. by 2⅛-in. furring strips, on which is laid a 13-16-in. bulkhead lining. Four layers of ½-in. insulation protect the lading next the bulkhead from too low temperature.



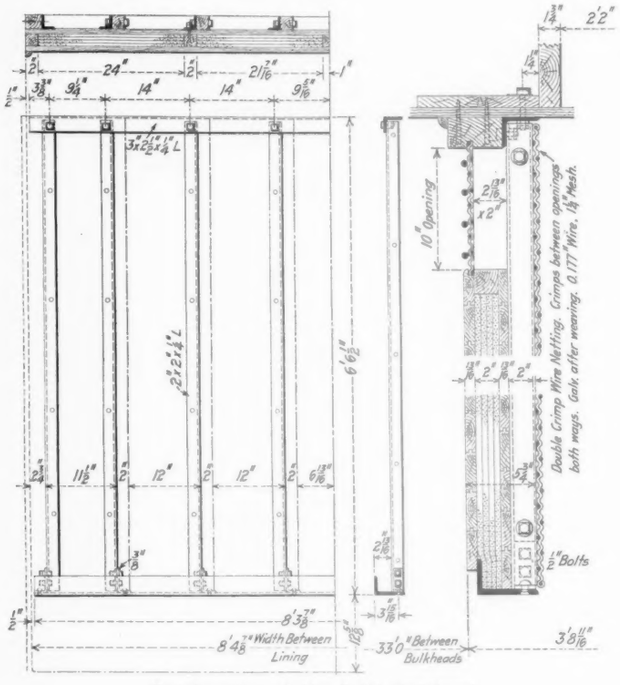
Arrangement and Design of Ice Compartments, Michigan Central Refrigerator Car

The bulkhead top rail is 2 in. by 2 in., extending the full width of the bulkhead, being nailed to the bulkhead post furring strips. The outside lining is 13/16 in., which is nailed to 2-in. by 2-in. furring strips in the bulkhead. An

opening 10 in. wide is provided at the top and an opening 12⅝ in. wide is provided at the bottom of the bulkhead.

The tank screen is made up of 0.177 wire with a 1¼-in. mesh. The netting on the side and rear of the tank is fastened to oak furring strips and at the front it is secured to the bulkhead post furring strips. The tank covers are insulated with four layers of ½-in. insulation. The openings in the roof are 20 in. by 27 in.

The opening at the bottom of the bulkhead is covered with a gate of 1½-in. diamond mesh made up of 0.177 wire, which is mounted on a frame of ⅞-in. by 7/16-in. channels. These gates are fastened to the angle bulkhead support by



Construction of the Solid Bulkhead

hinges. At the top a similar netting is used with four ½-in. rods applied as indicated in the drawings.

Among the specialties used on this car may be mentioned Miner roller side bearings, Western angle cock holder and card holder, Bettendorf trucks and Virginia dust guards.

The following are the general dimensions of this car:

Length over end sills	41 ft. 4¾ in.
Length inside of lining	40 ft. 5⅜ in.
Distance between ice tanks	33 ft.
Width over outside sheathing	9 ft. 5⅞ in.
Width inside of lining	8 ft. 4⅞ in.
Width over side fascia	9 ft. 9⅛ in.
Width of door opening	5 ft.
Height from rail to eaves	12 ft. 2¼ in.
Height from rail to over all	13 ft. 8⅝ in.
Height from top of floor to ceiling	7 ft. 7⅛ in.
Cubic feet capacity	2,026

PIPE LINE TRAFFIC IN DECEMBER.—The United States Geological Survey has issued a statement compiled from data received from 180 pipe line and refining companies that handle or receive oil direct from the productive fields east of the Rocky Mountains, showing that in December 1917, 19,867,143 barrels of crude petroleum were moved from field sources. The stocks of crude petroleum on hand at the end of December were 129,232,811 barrels. Statistics of petroleum movement in California are not included because of delays incident to procuring first-hand data. Except in the Oklahoma-Kansas field, the surface reserve of crude oil at the end of 1917 was appreciably less than at the end of 1916.

HOT BOXES ON FREIGHT CARS

BY F. W. SCHULTZ
District Foreman, Union Pacific, Grand Island, Neb.

The first and most conspicuous cause of hot boxes is inattention. It is too bad there is so much waste of oil on a poor bearing. If a bearing has been overheated all the oil in the country will not save it. It is then significant that a little mechanical ingenuity is necessary. It sometimes does not require a great deal of mechanical ingenuity to put a bearing in the proper condition. The fact that a bearing has been running in good condition indicates the mechanical construction is all right. If it is then not given attention and there is any lack of lubrication, the bearing will soon be destroyed. I venture to say inattention is practically the first and only cause of a bearing being heated, and is mostly the cause out and out of hot boxes on freight cars, or any other equipment. There is no question but what a large amount of oil is wasted; therefore the handling of packing and inspection of boxes on freight cars should be systematic.

There should be no reason why a card case could not be applied to a box car in a conspicuous place, and made uniform throughout the country, to carry a card showing the last time boxes were inspected, packed, or oiled. This is equally as important as the stencilling of a triple. If cards are applied in this case and were uniform throughout the country the same as other M. C. B. cards, there is no reason why journal box lubrication would not be given the same attention. Oil would be saved, as there is no doubt but that many times oil is applied when it is not necessary, also boxes would then be systematically inspected, packed and oiled.

It is commonly known that cars have been taken from industrial tracks where they have stood for several months; likewise cars that have been stored which have had all packing robbed from boxes, and put in trains without any attention. There has been no packing to burn, or smoke, and journals have burnt off, where if cards in card cases were noted by trainmen, or inspectors, the journal boxes, no doubt, would be given attention. It is easier to look at one card than eight journal boxes. The same car on an industrial track without an air hose would be immediately supplied, and a car would not be taken, either empty or under load, without an air hose. Usually this car is put on the head end of a train account of making time in switching, which is in the most dangerous place in the event a journal is burnt off.

To prevent journal failures no journal should be allowed to run if it has been red hot, as this journal when car is stopped is usually sprung. Many cars have been set out of trains along the road with a red hot bearing with a journal sprung, and car men will be sent to rebrass and repack, or apply a journal box and a water cooler. This same journal, no doubt, has never been reported as being red hot, and has not been noticed until it has gone to the lathe.

If this journal, regardless of how badly it has been sprung, will true up within the limit, it is usually put in service again. Fractures will invariably occur, and many times never discovered. This is why there are so many smooth journal ends setting in laboratories to be analyzed, and many trainmen have lost their jobs because a journal has been found in the end of a box which showed no heating except the heating from the stub end of the axle, which carried the journal box. This caused the burning of packing and the grinding up of the brass, the only thing left being a good smooth end of the journal in the journal box.

The necessary attention will undoubtedly eliminate hot boxes.

THE NEED OF A BUSINESS BOX CAR*

Commercial Functions Should Be Considered with Mechanical Details. Better Designs Are Necessary

BY W. J. BOHAN
Mechanical Engineer, Northern Pacific

IT is my intention to offer a few remarks on the business of a box car and the relation of its construction thereto. I am taking the box car, as that type appears most frequently in interchange, and is probably receiving the greatest attention at the present time. An impression of the importance of box cars as they affect dividends can be gained from the following facts:

A total of 261,100 box cars were owned and operated by eight leading western and northwestern railroads during the last year, or an average per road of approximately 32,600. The total number of box cars represents 50.7 per cent of the total freight cars owned by these roads. These box cars may fairly be said to represent an original investment of $210,000,000.

The average total cost of repairs per road per year for a four-year period for all classes of cars was $3,481,000. The average cost of repairs per car per year was $64. The minimum cost per car per year for one of the roads was $41. The maximum cost per car per year was $110, a difference between minimum and maximum cost per car per year of $69, or $5 more than the average cost of repairs per car per year for all the roads mentioned.

The character of transportation on each of these roads is the same and the ratio of the number of box cars to the total number of freight cars of all classes is very nearly the same. It is fair to assume for the purpose of this paper that the above repair cost ratios for the different roads would obtain for box cars.

The claims paid for losses due to grain leakage by a large grain carrying line of the same group of roads for four years ending in 1917, averaged $80,000 per year, grain being carried in both owned and foreign cars. The average damage claims paid per year on account of defective equipment on all commodities other than grain for the same period was $17,000.

A stockholder of an inquiring turn of mind, or the president of one of these railroads, in view of the high loss and damage costs and wide difference in repair figures, would be justified in asking, "What is the matter?" Several things are the matter, and one of them is undoubtedly lack of business balance in car construction—box car construction—that being the type of car under consideration.

IMPROVED BOX CAR DESIGN NEEDED

For years mental and physical energy have been spent on box car design by the best and most loyal of men both technical and practical, and a generally satisfactory box car is not yet with us.

Have we kept it back by a flux of figures on stresses and strains lacking the leaven of sound engineering judgment? Have we delayed its coming by building upon too narrow conceptions of the problem? Have we co-operated with each other sufficiently in treating a large subject in a large way, by exerting our energies toward a broad and careful analysis of the subject, with a full realization that box cars are business agents of the railroads that own them, and that their dividend earning capacity depends upon their commercial efficiency as well as upon their mechanical details, and have we realized that the two qualifications are correlated? The fact that we haven't the generally satisfactory box car indicates at least that the progress of its development has been slow. The time has arrived when we must develop an efficient box car in its fullest sense. The unusual volume of business, the shortage of equipment, the scarcity of labor and material with the constantly upward trend in the prices of both, demand it. What have we got to offer in the way of a business box car?

The business box car must be free from leakage of lading, it must be weather-proof and practically fire-proof, it must have a so-called non-sweating interior free from projections and pockets, it must have properly dimensioned door openings and substantial free positive functioning doors and fastenings, and be so constructed as to lend itself to diversified lading with the incidental supplementary doors, blocking, etc. In short, it must be a car popular with the shipper—a dividend earning unit having a maximum demand.

It must, in addition to these qualities, have a minimum light weight, a maximum utility and carrying capacity per unit of weight, reasonable first cost, and freedom from mechanical defects. Two principal elements enter into the design and construction of such a car. First, accurate technical engineering information, and second sound, practical business judgment based upon experience, the latter largely predominating for the reason that evidence is lacking that anyone ever reduced the things that happen to a box car to conclusive figures.

In a recent article in one of the railway magazines a statement was made that in train service the car body has three movements, all of which absorb a part of the force applied at the couplers. This is true as far as it goes, and if this were all, figuring would be comparatively easy. It, however, stops where the real trouble begins. The fact of the matter is that the box car is subject not only to these three forces, but the resultant of their combined action and many others of such varying direction, intensity and rapidity of occurrence that their accurate mathematical determination is out of the question. Among these forces may be mentioned those due to poorly balanced designs, unevenness of track, curvature, centrifugal force, train handling, draft action, irregular lading, the shifting of lading, varying atmospheric conditions, etc.

Briefly, all of these forces combine in what may be called "team work" against the life of the box car. Close observation and experience with a large number of different types of box cars indicates that the general and greatest result of this team work manifests itself in twisting the car. Such being the case, then team work in an opposing direction by the various members of the car must be the natural antidote.

I believe the most economically efficient box car to be one in which every detail, even the grab iron, is made to do its fair share in assisting the natural functions of the car and resisting the stress and abuse to which it is exposed. The body of such a car should not be built around any one member, but all of its members should form a unit having maximum inherent strength and resilience and acting as a unit in dissipating all reasonable strain action. It should have the fewest possible primary and special parts in that joints, gussets, rivets, bolts and fastenings which work and

*Abstract of a paper presented at the Western Railway Club.

wear to the detriment of the car, increase its cost of upkeep and cause a considerable loss of time on repair tracks.

GENERAL SPECIFICATIONS

A general specification for a car that would meet the requirements outlined would be briefly as follows:

The weight for a 40-ft. 40-ton box car should be between 45 and 50 per cent of the stenciled capacity. I should say it should not exceed 48 per cent. This weight can be obtained without sacrifice of strength.

The body should be steel framed throughout, preferably of pressed steel of resilient quality. The underframe, sides, ends and roof should be diagonally braced throughout. There is no question about the efficiency of diagonal bracing. Its value has been many times demonstrated in the reclamation of thousands of old cars. As the diagonal bracing of the entire construction will distribute the strains due to the live load and shocks to all members of the car, the fish belly type of center construction is not necessary. Center sills ten inches deep and of ordinary cross section are sufficient.

The side and end posts and braces, at the points of attachment with sills and plates, underframe bracing at the points of attachment with center and side sills, and roof bracing at the points of attachment with ridge pole and plates, should be directly connected, that is, the usual construction using gusset plates or other secondary members should be eliminated as the strength and efficiency of the car can be materially increased by so doing, and unnecessary parts eliminated. Autogenous welding may be used to material advantage in such a construction.

The diagonal underframe bracing at the ends should be securely tied to both the center and end sills at their junction, and extend continuously around the ends of the body bolster and cross ties, with alternate connections to the center and side sills. The same general construction may be followed in the roof for the attachments of the diagonal bracing and plates, ridge pole and door carlines. At the door openings the underframe should be substantially reinforced by supplementary diagonal bracing. The plate may be similarly reinforced above the door, or the door track constructed to form the reinforcement. The roof reinforcement at the door openings may be made by the use of carlines at the door posts. The end construction with its attachment to end sills and plates should be similar to the side construction.

The corner posts should be formed by directly connecting the end side post and side end post members throughout their entire length. This will not only tie the car together securely but it materially assists in forming an integral construction. The corners may be further reinforced by continuous corner and end grab irons. The side and end sheathing should be constructed of two sections of sheet steel, their junction reinforced by plates, and all securely riveted together forming side and end girths, the girth reinforcing plate extending continuously from side door post to side door post around the end of the car. The end and side lining should be of matched lumber, the sides ¾ in. or 13/16 in. thick, the ends 1¾ in. thick, the lining extending from floor to plates. The floor may be of the usual 1¾ in. matched stock secured to furring strips on the underframe, using standard grain strips at the intersections of the floor and the sheathing.

The roof should be of the circular type and may be constructed of two sheets of No. 16 steel running lengthwise of the car, with a joint at the ridge pole, the two roof sheets being securely riveted between the ridge-pole and a weather proof ridge-pole cap. The roof sheets should also be securely riveted to the diagonal braces, end and side plates, thus forming an integral member of the car capable of sustaining its share of the load. It is necessary that the inside of the roof be what is commonly called "non-sweating." This can be taken care of by the application of a heavy coat of ground cork and red lead or mineral paint applied to the exposed metal surfaces.

The door should be of steel, framed and sheathed similar to the body of the car, and mounted with weather-proof shields at the posts and plates.

The truck should, like the body, have as few parts as possible and be preferably of the cast steel type. Particular attention should be given the brake beam mounting to insure even brake shoe wear and proper alinement of levers and rods. All of these points are of extreme importance not only in that they may perform their special functions properly, but that irregular transmission of stresses to the car itself be avoided as far as possible. Brake equipment of standard makes is quite satisfactory. Special attention, usually lacking, to secure proper application and alinement of parts, is absolutely necessary to obtain safe and efficient results.

The draft gear should be of the friction type having a minimum recoil action, which should be just sufficient to readjust the parts in release. The travel should be approximately four inches. The shock dissipating capacity should be the maximum obtainable with prescribed travel and standard clearance conditions. The draft lug fastenings should approach strength sufficient to resist the maximum shocks regardless of draft gear capacity.

The holes in the framing should be die punched to templets. All rivets and bolts should be of the best quality obtainable and of dull cross section. Bolts should have properly proportioned heads and clean cut and accurate threads to provide for wrench fit of nuts. Nuts should also be of the best quality and manufacture. The application of both rivets and bolts should be made without drifting, rivets having full and concentric heads and driven at the proper temperature.

Double nuts, lock nuts, cotters and split keys where used should be given special attention. I consider a good design of nut lock superior to a cotter or split key on account of the extreme difficulty in getting proper application of cotters or split keys. No one little thing is a source of more trouble on a car than loose nuts.

Too much stress cannot be placed upon the importance of more careful practical engineering study of both general and detail design to secure a well balanced, resilient car unit. Some manufacturers have done a great deal of excellent work in this direction on underframes, but have not in my opinion extended the resilient features far enough, as there is no reason why it should not extend to the entire superstructure. Particular attention should also be given to the selection and assembly of the best material that can be obtained.

In conclusion, it must always be borne in mind that the most efficient business box car is one so constructed and assembled that it will afford a maximum resistance to the development of chronic conditions arising from general and not maximum service stress. Such a car, reasonably maintained, will have the physical strength to take care of reasonable maximum stresses and at the same time represent a minimum first cost and up-keep, and be commercially efficient.

DISCUSSION

W. G. Wallace (American Steel Foundries): The M. C. B. couplers provide for angling of 15 deg. with a total side clearance of couplers of 2½ in., giving 1¼ in. on either side of the coupler shank between the legs of the striking casting. With the coupler yoke and draft gear attachments when the overhang or the distance between the center line of bolster and pulling face of the coupler is of such length that the length of car and the curvature of track will bring

the couplers so far from the center of the track that the present angling will not permit of free movement, but binds the couplers, distorting guard arms, split faces and exerts a pressure between the sills tending to spread them apart and in some cases breaking the striking castings by reason of the pressure applied sideways. This puts a strain on the center sills, increases the pressure of the flanges against the rails, also the train resistance and in a measure increases the liability of derailment. If you will observe some of the cars of recent construction, you will find many of them have the striking castings with the lugs projecting on either side of the coupling, you will find them all split and distorted and broken and it looks to me that when you do not provide that proper angle, with your heavy tonnage train and motive power, that you are putting the stress in that car that, if it could be reasonably avoided, it would be advantageous to do so.

G. S. Goodwin (C., R. I. & P. Ry.): I notice the author says, "The body should be steel frame throughout. . . . The underframe, sides, ends and roof should be diagonally braced throughout. There is no question about the efficiency of diagonal bracing."

I agree with the author on the efficiency of diagonal bracing, but I want to recall a little experience I had several years ago with a 50-ft. steel frame furniture car. The car had fish-belly sills designed to carry the entire load, so that the steel side frame had only to prevent the sides bulging. The car was 10 ft. high inside, and the roof was diagonally braced. The cars derailed in the yard, and in going into the matter we found, due to the extreme distance between the trucks, that on a curve one truck might be elevated on one side considerably more than the other. This brought the diagonal side bearings into contact, and since the body of the car could not twist on account of the diagonal bracing in the roof, and the truck was stiff, the car derailed. We proved the tendency of the body of the car to twist by cutting one of the braces when the car stood on a curve. It opened up about 1½ in. Since that experience I try to analyze the effect of the diagonal bracing before I use it. The distance between side bearing centers on this car was 60 in., center to center.

Mr. Bohan: I consider 60 in. too much. I do not believe that a car having a free working truck of reasonably good design can be derailed under ordinary conditions if the load remains on the center plate. I have recently seen some new refrigerator cars equipped with roller side bearings spaced 60 in. center derail on rough straight track or on curves improperly elevated, as fast as they could be rerailed. In all cases the load was lifted from the center plates and transferred to diagonally opposite side bearings, unloading the wheels on the opposite sides of the trucks. The trouble was corrected in the particular case in mind by increasing the side bearing clearance to compensate for the irregular track or improperly elevated curves. I have until recently considered 56 in. between side bearings sufficient, but I am now convinced that 48 to 54 in. would be better.

E. G. Chenoweth (C., R. I. & P.): I want to add a word relative to the car that Mr. Goodwin spoke of, especially in reference to the location of side bearings of the car that derailed. This car, in order to ascertain just what was the cause of the derailment, had its side bearings applied very close to the center plate, as close as possible, then it was moved out toward the end of the bolster a few inches at a time and tested each time to see if it would derail. No location of side bearing stopped the derailing. The side bearing clearance was changed and it still derailed. After that we took the side bearings off entirely and the car still derailed. Therefore it is my belief that in some equipment the side bearing has nothing whatever to do with the derailment. It is due to something else entirely.

Robert Quayle (C. & N. W.): There is a suggestion in the paper as to the relative cost of maintenance of cars. I think it is hardly fair to assume that you can have an equal cost on all roads, even though the cars may be of the same design and construction. Here is a railroad that will not change its trains for perhaps 500 miles or more, and some other railroad will have to change that train every 30 or 40 miles. The effect of the switching is magnified and the effect on the framing is intensified. The results you know. If you can get along with very little switching, you are going to get along with very little cost of maintenance. The topography of the road has much to do with the maintenance of cars and equipment.

I think it would be a good thing for us to have a standard car and I am willing to vote for something of that kind. I am willing to throw away a good many of my notions, they may be old fogy, some of them are. I will exchange my views with yours and I will swap something with you and then the East and West, North and South, can get a car that will answer our purposes very well and give the service required. I am willing to do it and we ought to be patriotic along that line, just the same as we now cover all sectional divisions and we are all Americans, fighting for one thing, democracy and the liberty of humanity.

RUN REPAIR OR TRANSFER*

BY F. W. TRAPNELL
Chief Interchange Inspector, Kansas City, Mo.

Having been asked to write a paper on some live topic, I chose the above after I read the article under the above caption in the *Railway Mechanical Engineer* of January issue which reads:

"The transfer of loaded cars in large terminals has become a live issue in these times of shortage of equipment, and some advocate the ancient custom of Run Repair or Transfer, at receiving line expense."

The above would be all right if all equipment were in equal condition, but we do not find that to be the case and to go back to that old obsolete rule would cause a great deal more transferring than is done now, as the originating line would not pay any attention to the vehicle that is loaded because the receiving line would have to assume all the expense even with the penalty attached of paying for the transfer. Some roads are not giving any attention to the condition of the car that is set for loading and then complain of the number of transfers allowed against them, where if the proper care had been given the cars before loading, the transfers would be cut down 80 per cent. A great many cars are repaired, splicing draft sills and putting on end sills, etc., in loaded cars, that can be done where the car is loaded so that such repairs can be made, but there is a vast number of cars that the commodity has to be one-third to one-half unloaded to get at the work, in that case it would be expediting the freight to transfer it. The receiving line not being responsible for the condition of the car, they should not be held responsible for the transfer, or in other words, penalized for the carelessness of the originating line in not loading a good order car. M. C. B. Rule No. 2 is really a run repair or transfer rule, it outlining the defects that must be repaired while car is loaded and moved forward. Should the line receiving not wish to repair these defects, they do the transferring at their own expense.

The best way to economize is to see that the vehicle is in proper shape before loading and if not repair it. This will eliminate many load transfers and save considerable time. As it is, any car that happens to be handy is usually sent

*From a paper presented before the Southwestern Carmen's Club of Kansas City.

to a plant for a load and no attention is paid to its physical condition.

Proper supervision is not given to the loading of cars; they are loaded without door protection, allowing doors to bulge out and get off the track or out of the guides. Gondolas are not properly loaded, the load being allowed to shift to one side, contributing to the derailment of cars. Loads on other cars are not properly staked or blocked, or the bearing piece is improperly applied. The shippers should be furnished with a book of the loading rules and made to comply with them. This would be a good investment to the railroad company.

And where any transfer order is issued a statement should be made showing where the car was billed from and where to, with such other information as would help the general officers to get after the point of origin and get the agent lined up on the loading so as to save the expense of transfer or adjustment.

STRESSES IN BOLTS IN FULCRUM BRACKETS

BY VICTOR M. SUMMA

The design of bolted fastenings subject to heavy stresses, such as the fulcrum brackets for brake bell cranks and similar parts, at first sight seems to present little difficulty. In certain types of brackets, however, there are combinations of stresses, the resultant of which is by no means easy to determine. Designers sometimes fail to take account of the secondary stresses in such members, with the result that the bolts are stressed beyond the elastic limit, making it necessary to replace them at frequent intervals.

The general principles involved in the design of brake

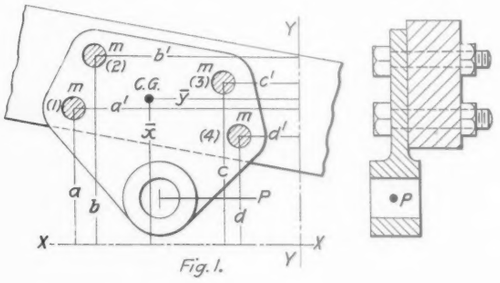


Fig. 1.

fulcrum brackets are of such wide application that it may be of interest to analyze a few typical cases. The fastening of the bracket shown in Fig. 1 is one of the simplest forms. The bolts are all in one plane and there is no shoulder to assist in holding the part in position. A bracket held in this way will tend to revolve about the center of gravity of the bolts and in calculating the stresses, this point must first be found. This can readily be done by taking two axes at right angles. The distance from each axis to the center of each bolt is measured and multiplied by the area of the bolt. The sum of the products is then divided by the total area of the bolts, which will give the distance of the center of gravity from the axis. Thus in Fig. 1 if the area of each belt is M and the distance from the axis respectively a, b, c and d, the distance of the center of gravity, from the axis xx will be

$$\frac{am+bm+cm+dm}{4m}$$

In the same way the distance of the center of gravity from the axis yy can be found.

This relation can be expressed by the general formulæ

$$x = \frac{\epsilon mx}{\epsilon m} \text{ and } y = \frac{\epsilon my}{\epsilon m}$$

in which x and y are the respective distances of the center of gravity from the two co-ordinate axes, Σmx and Σmy are the products of the areas of the bolts by the distances from the axes and Σm is the total area of the sections of the bolts.

The condition of equilibrium under the force P, acting at the center of the hub, is shown in Fig. 2, in which the individual resistances of the bolts are marked p and $Q1$, $Q2$, $Q3$ and $Q4$. The reaction p for each bolt must be parallel to P and equal to $\frac{P}{n}$, where n is the number of bolts in the flange. The forces $Q1$, $Q2$, etc., which counteract the moments of the force P, about the center of gravity

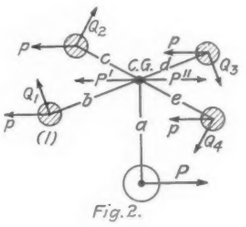


Fig. 2.

(Pa) act at right angles to the arms b, c, d and e, as indicated in the diagram. It will also be readily seen that if $Q1$ is the resistance offered by the bolt farthest from the center of gravity, the resistance offered by the other bolts will be smaller in proportion to their respective distances from the origin, or center of gravity. In other words, if Q represents the resistance at unit distance, the actual resistance of the bolts at distances b, c, d and e will be Qb, Qc, Qd and Qe.

Equating the moments of these forces about the center of gravity to the amount of the force Q, we have

$$Pa = Qb^2+Qc^2+Qd^2+Qe^2=Q(b^2+c^2+d^2+e^2)$$

or,

$$Q = \frac{Pa}{b^2+c^2+d^2+e^2}$$

From this we can derive the formulæ for the secondary resistance of the bolts.

$$Qb = \frac{Pa \times b}{b^2+c^2+d^2+e^2}$$

$$Qc = \frac{Pa \times c}{b^2+c^2+d^2+e^2}, \text{ etc.}$$

The principle illustrated by these formulæ may be stated in the following general rule: To find the total secondary

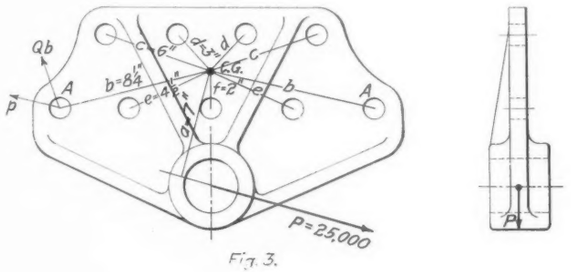


Fig. 3.

stress of each bolt or rivet divide the moment of the given force P about the center of rotation (in this case the center of gravity of the bolts) by the sum of the squares of the distances of the bolts from the center of rotation, and multiply the result by the distance of the bolt under investigation from the center of rotation.

By the composition of forces the resultant of each of the secondary resistances and the direct resistance, p, can be

found, which will give the resultant load to be carried by the bolts.

A few examples taken from actual practice will give an idea of the value of the principles just discussed to the designing engineer.

Example 1.—It is required to find the unit stress in the most strained bolt in the fulcrum bracket for locomotive

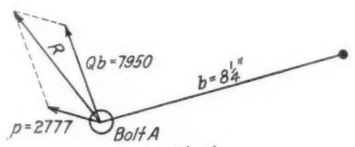


Fig. 4.

driver brakes shown in the sketch (Fig. 3). The bolts are all ¾ in. in diameter and the force P at the hub is 25,000 lb.

The greatest stress will obviously occur in bolts A. Then: Direct resistance =

$$p = \frac{P}{n} = \frac{25{,}000}{9} = 2{,}777 \text{ lb.}$$

Secondary resistance =

$$Qb = \frac{Pa \times b}{2b^2+2c^2+2d^2+2e^2+2f^2}.$$

The distance from the center of gravity of the bolts to the line of action of the force P is found to be 7 inches. Then,

$$Qb = \frac{25{,}000\times7\times8.25}{2\times8.25^2+2\times6^2+2\times3^2+2\times4.5^2+2^2} = \frac{25{,}000\times7\times8.25}{182.31} = 7{,}950 \text{ lb.}$$

By graphics, as indicated in Fig. 4, the resultant, R, is found to be 8,740 lb., from which the shearing unit-stress is

$$v = \frac{8740}{0.44} = 19{,}800 \text{ lb. per sq. in.}$$

Example 2.—In Fig. 5 is shown a familiar design of corner connections. A force P (9,000 lb.) is transmitted

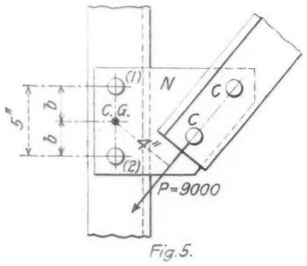


Fig. 5.

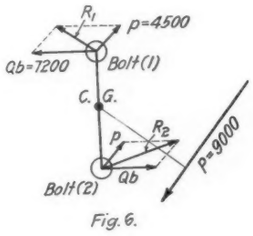


Fig. 6.

to plate N through the rivets C. Find the stresses in rivets (1) and (2), their diameter being ⅞ in.

The center of gravity of rivets (1) and (2) is, of course, the middle point of their pitch-distance, i.e. 2½ in. from each rivet. The arm of the moment P about the center of gravity is 4 in. Then, as before—

Direct resistance =

$$p = \frac{P}{n} = \frac{9000}{2} = 4{,}500 \text{ lb.}$$

Secondary resistance (alike in both rivets) =

$$Qb = \frac{Pa \times b}{2 \times b^2} = 7{,}200 \text{ lb.} = \frac{9000 \times 4 \times 2.5}{2 \times 2.5^2}$$

and their two resultants (see Fig. 6) are—

$$R1 = 5{,}220 \text{ lb.}; \quad R2 = 10{,}900 \text{ lb.}$$

or, unit stress in rivet

$$(1) = \frac{5220}{0.6} = 8{,}700 \text{ lb. per sq. in.}$$

unit stress in rivet

$$(2) = \frac{10{,}900}{0.6} = 18{,}200 \text{ lb. per sq. in.}$$

In the solution of such problems as these the mistake is often made of assuming the wrong direction for the force p or Qb. It should be borne in mind that the resistances offered by the bolts, being reactions of the force P and the couple Pa, always act in the direction opposite to the action of these forces.

In Fig. 7 is shown one type of bracket extensively used on locomotives as a shaft support in the brake rigging. The fulcrum of the cylinder lever is at the point M and in this case the reaction, P, of the air pressure and the pull at the connection rod is 50,000 lb. Under the action of the force P the bracket tends to slide along the frame and also to turn about the line OO. It is obvious that the force P has also a tendency to turn the bracket about the line KK which

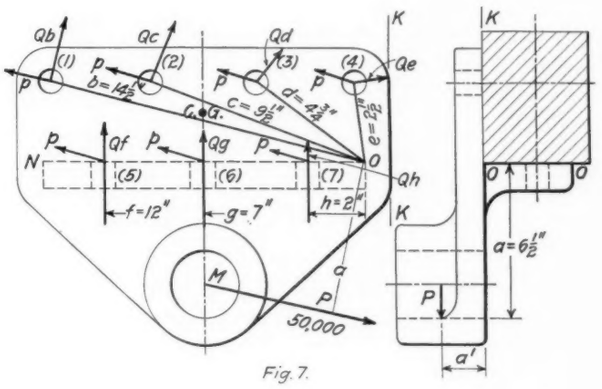


Fig. 7.

must be considered. It is required to find the intensity of the stresses in the bolts due to this force, P.

The direct resistance of each bolt to the force P is evidently

$$\frac{50{,}000}{7} = 7{,}140 \text{ lb.}$$

indicated in the sketch by the letter p. The forces produced in the bolts by the turning moments of the couple Pa about OO, will oppose to Pa, not their moments about the center of the gravity of the bolts, but their moments about the edge OO, around which the casting is bound to revolve. Also, if Q is the resistance to unit distance, and $b, c \ldots . h$, the corresponding distances of each bolt from O-O, the actual resistances offered by the bolts will be Qb, Qc, Qd, etc., and their moments, Qb^2, Qc^2, Qd^2, etc. The condition, then, which must be satisfied for equilibrium of rotation is given by the equation

$$Pa = Q(b^2+c^2+d^2+e^2+f^2+g^2+h^2);$$

as before.

Hence the secondary resistance of bolt (1)

$$Qb = \frac{Pa \times b}{b^2+c^2+d^2+e^2+f^2+g^2+h^2}.$$

Secondary resistance of bolt (2)

$$Qc = \frac{Pa \times c}{b^2+c^2+d^2+e^2+f^2+g^2+h^2}$$

and so forth for the result of the bolts.

Hence, substituting for a, b, c, etc., their values given in the sketch, we have for the resistance of bolt (1)

$$Qb = \frac{50{,}000\times6.5\times14.5}{14.5^2+9.5^2+4.75^2+2.5^2+12^2+7^2+2^2} = \frac{50{,}000\times6.5\times14.5}{526} = 9{,}000 \text{ lb.}$$

Since the force P acts at considerable distance from the plane of the vertical flange there is also a turning moment about the line KK which is too great to be neglected. (In case the forces from the inner and outer sides of the

hub do not act in the same direction, the moments caused by their combined action should also be considered.) In this case the moment is equal to Pa', and causes tension in the bolts in the vertical flange and shearing stresses in those in the horizontal flange.

From the formula

$$Q1b1 = \frac{Pa \times b1}{b^2+c^2+d^2+e^2+f^2+g^2+h^2}$$

Substituting the proper values, see Fig. 8, we have for the resistance of bolt (1)

$$Q1b1 = \frac{48{,}750\times2.5\times16}{16^2+11^2+6^2+1^2+13^2+8^2+3^2} = \frac{48{,}750\times2.5\times16}{656} = 2{,}970 \text{ lb.}$$

Tensile unit stress =

$$p = \frac{2970}{0.994} = 2{,}990 \text{ lb. per sq. in.}$$

The resultant, R, of the direct resistance p and of Ob is found graphically to be 11,000 lb. (See diagram Fig. 9). The shearing unit stress in the bolt =

$$v = \frac{11{,}000}{0.994} = 11{,}080 \text{ lb. per sq. in.}$$

Since the bolt (1) is subjected to a shearing stress as well as a tensile stress it is necessary to find the maximum combined stresses. This can readily be done by using the formulae

$$T = \tfrac{1}{2}\, p + \sqrt{v^2 + \tfrac{1}{4}\, p^2} \quad (1), \text{ and,}$$

$$S = \sqrt{v^2 + \tfrac{1}{4}\, p^2} \quad (2)$$

Where T = maximum tensile unit stress
S = maximum shearing unit stress
p = applied tensile unit stress
v = applied shearing unit stress

Substituting the values already given for p and s we find:

$$T = \frac{2{,}990}{2} + \sqrt{(11{,}080)^2 + \frac{(2{,}990)^2}{4}} = 12{,}660 \text{ lb. per sq. in.}$$

$$S = \sqrt{(11{,}080)^2 - \frac{2{,}990^2}{4}} = 11{,}170 \text{ lb. per sq. in.}$$

Let us now investigate the nature and intensity of the stresses in one of the bolts in the horizontal flange O-N. The

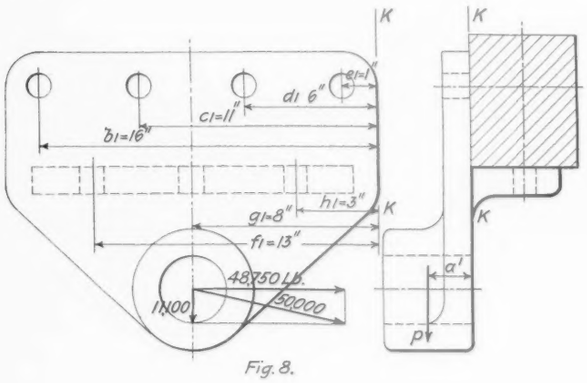


Fig. 8.

worst case is obviously that of bolt (5). Here we have—

Secondary resistance =

$$Qf = \frac{50{,}000 \times 6.5 \times 12}{526} = 7{,}400 \text{ lb.}$$

which is in the nature of a pull.

The moments of the component of P about KK also causes a shearing stress in this bolt.

$$Qf = \frac{48{,}750 \times 2.5 \times 13}{656} = 2{,}420 \text{ lb.}$$

Shearing unit stress=

$$\frac{2{,}420}{0.994} = 2{,}430 \text{ lb. per sq. in.}$$

There is also the direct resistance p which was already found to be 7,140 lb. As this force p is inclined to the axis of the bolt it is necessary to resolve it into its component in the direction of Qf and of its normal. These are shown in the adjacent sketch Fig. 10, where p' represents an additional pull of 1,000 lb. and p'' a shear of 6,700 lb. Then, tensile unit-stress,

$$p = \frac{7{,}400 + 1{,}000}{0.994} = 8{,}460 \text{ lb. per sq. in.;}$$

shearing unit-stress =

$$v = \frac{6{,}700}{0.994} = 6{,}730 \text{ lb. per sq. in.}$$

combining this with the shearing stress of 2,430 lb. per sq. in. due to the moment Qa', we find the combined shear to be 7,170 lb. per sq. in. The solution of the problem would be incomplete if we did not ascertain whether bolt (5) is

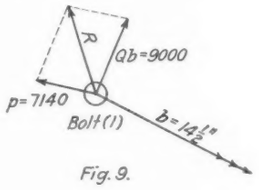


Fig. 9.

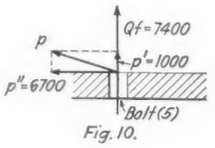


Fig. 10.

capable of withstanding the combined effect of the shearing and tensile stresses.

Substituting for p and v, in formulæ (1) and (2), their values found above, we have

$$T = \frac{8.460}{2} + \sqrt{(7{,}170)^2 + \frac{(8{,}460)^2}{4}} = 12{,}550 \text{ lb. per sq. in.}$$

$$S = \sqrt{(7{,}170 + \frac{(8{,}460)^2}{4}} = 8{,}320 \text{ lb. per sq. in.}$$

In the same way the stresses in the other bolts may be determined, although it is clear that these stresses can not be higher than those just found. While there are certain approximations involved in this method of calculating the stresses in bolts, the slight errors which they might cause are negligible as compared with the variations due to inaccuracies of workmanship. The stresses in bolts as determined by this method are well within the limit of accuracy required in the ordinary problems of design.

SMOKELESS FUEL FROM WOOD WASTE.—A process for making smokeless fuel from wood waste is in course of development at Nanaimo, British Columbia, according to a report from American Consul R. D. Mosher, stationed at Victoria, B. C. It is estimated that 15,000 cords of wood waste are now destroyed daily in the province. By the new process this material would make 10,000 tons of smokeless fuel. It is said that this fuel can be produced at the factory for $2.50 a ton. The fuel is made by a progressive distillation process, carried on entirely by means of heated and cold gas, and no foreign substance enters into it.—*Weekly Telegraph.*

MAIL TO BE SENT BY AIRPLANE.—The postmaster general proposes to establish aerial transportation for letters, on one route, as soon as practicable, and has asked for bids for the construction of five airplanes for an aerial route for the delivery of first-class mail between Washington, Philadelphia, and New York, making one round trip per day. The contract will be awarded to the bidder whose airplanes have stood satisfactory service test in the war and navy departments. It is the purpose of the postoffice department to make this a permanent service. An appropriation of $100,000 is available. The intention is, as soon as the authority of Congress is received, to establish a through aerial route to Philadelphia and New York, carrying 300 pounds of first-class mail, for the transmission of which a special postage rate will be charged, not exceeding 25 cents an ounce.

SHOP PRACTICE

AIR COMPRESSOR TABLE

BY J. H. HAHN

A particularly substantial and useful table for the support of all sizes of air compressors while being repaired, has been designed by F. P. Brotherton and the writer and tried out with good results in the Norfolk & Western shops at Bluefield, W. Va.

This device is made up, as shown in the illustrations, of a hinged table mounted on the upper end of a piston rod, the piston and cylinder of which are beneath the floor. A

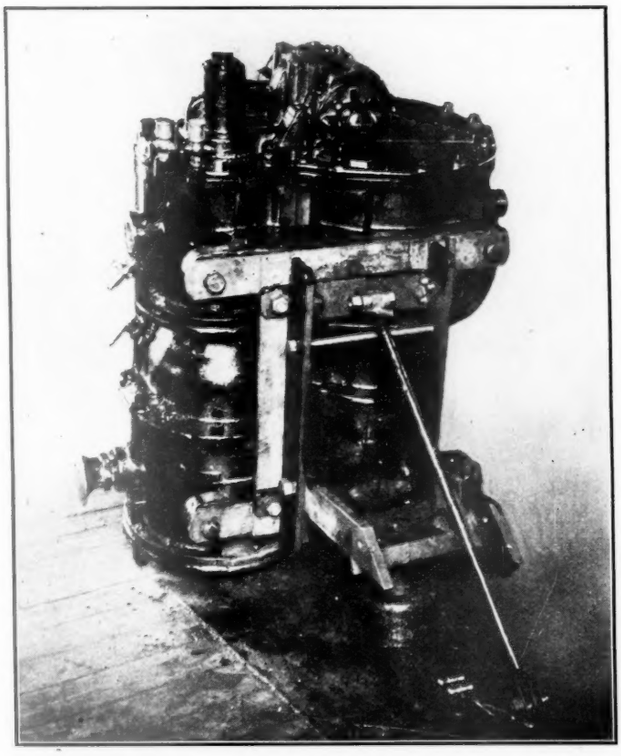


Fig. 1—Air Compressor Bolted to the Table and Ready to be Lifted

movable arm, connected at one end to the floor and at the other end to the free side of the table, causes it to change from a vertical to a horizontal position when the piston rises.

In operation the compressor is up-ended and bolted to the table as shown in Fig. 1, the air being released from the cylinder. When it is desired to raise the compressor, the air is turned on and the piston begins to rise. This lifts the lower end of the table, but the upper end is restrained by the movable arm so that it gradually tips until with the piston in its extreme upper position, the table and compressor rest horizontally as shown in Fig. 3. The table is then locked by means of a long pin extending through the frame at the top of the plunger. The arm is removed so it will be out of the way of the repair man. Before going ahead with the repair work, a sheet iron sleeve is put around the piston rod,

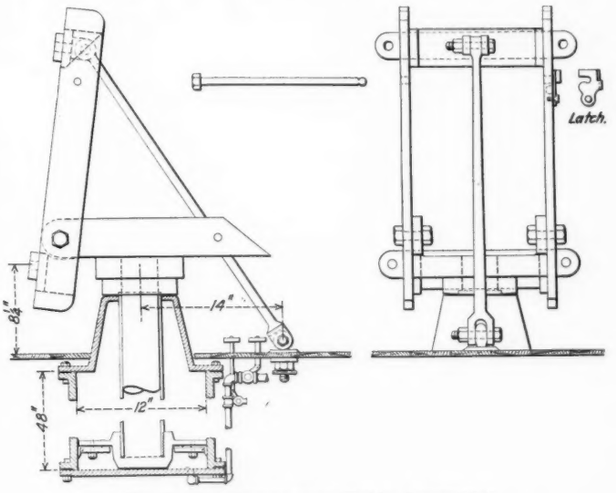


Fig. 2—Air Compressor Table Assembled

and the cylinder air pressure released. The sleeve then holds the pump at the required height and prevents waste

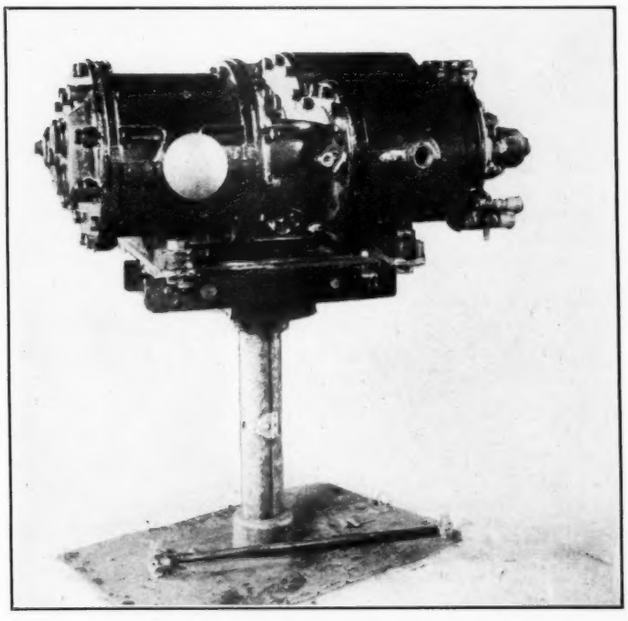


Fig. 3—Air Compressor Lifted and Ready to be Overhauled

due to air leakage by the cylinder packing leather. If more convenient for the workman, sleeves of different lengths may

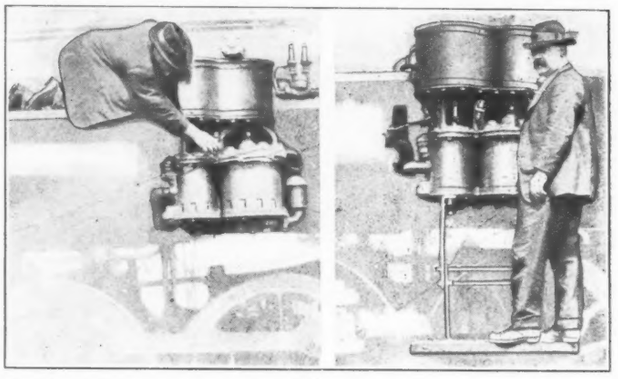
be provided, which with the arm attached will hold the compressor at any required angle desired. By providing auxiliary brackets which may be applied to the table, it may be used for making repairs to all sizes of compressors.

Details of the arrangement, shown in Fig. 4, give the dimensions used in this particular case, but they are subject to change as occasion may require. The piston rod is turned to a loose fit in the cylinder sleeve and has a shoulder on the upper end. The yoke or part that fits on the upper end of the rod is forged in one piece and this insures the necessary strength and stiffness. The hinged table is built up of 2½-in. by ¾-in. stock, strongly braced and riveted together. The auxiliary bracket shown in the lower left corner of Fig. 4 is of the right dimensions to support a 10½-in. Westinghouse cross compound compressor, but it may be made to suit any size or type of compressor. The cylinder used was an engine truck pit jack cylinder 12 in. in diameter, having a 48-in. stroke. But here again the selection is an arbitrary matter and any available cylinder large enough to handle the work may be used.

Many air brake foremen have felt the need of a substantial and durable compressor repair table and these qualities are possessed by the one just described. In addition, it does away with the necessity for air hoists, runways, chain falls or blocking. There are no legs to get in the way of the repair man and the compressor may be adjusted to any height or angle required. Also on account of the whole arrangement being rigid, it is easy to tighten cap screws, air cages, piston rod nuts, etc. All of these advantages and good features combine to make a repair table which has given good satisfaction at Bluefield shops and in fact, actually increased the output or number of compressors which are repaired per month.

AIR COMPRESSOR OILING STEP

On many locomotives the running board comes either on a level with or above the air compressor, and for proper inspection and oiling it is necessary to stoop down and reach around the pump as shown in the left of the illustration. This is not only an awkward position to be in, but dangerous as well, due to the chance of slipping. Greasy hands, icy handholds, or a sudden bump may result in a serious, or perhaps fatal fall.



The Danger in Oiling a Pump by the Old Method is Avoided by a Safety Step

The safety step shown in the right of the illustration was devised by S. M. Dickerson, an engineman on the Missouri, Kansas & Texas, at Ft. Worth, Texas, and it has been used successfully on a number of locomotives belonging to that road.

The step shown is of a hinge type and may be folded up under the compressor when not in use. The sides are made of ½-in. by 2-in. wrought iron, securely bolted to the bottom of the pump. The rounds are of ⅝-in. round iron with the ends turned down to ½ in. where they go through the side frames. They are left long enough so that they may be headed over.

The estimated cost of manufacture of this safety step is $6.50, which figure could be materially reduced if large numbers of steps were made.

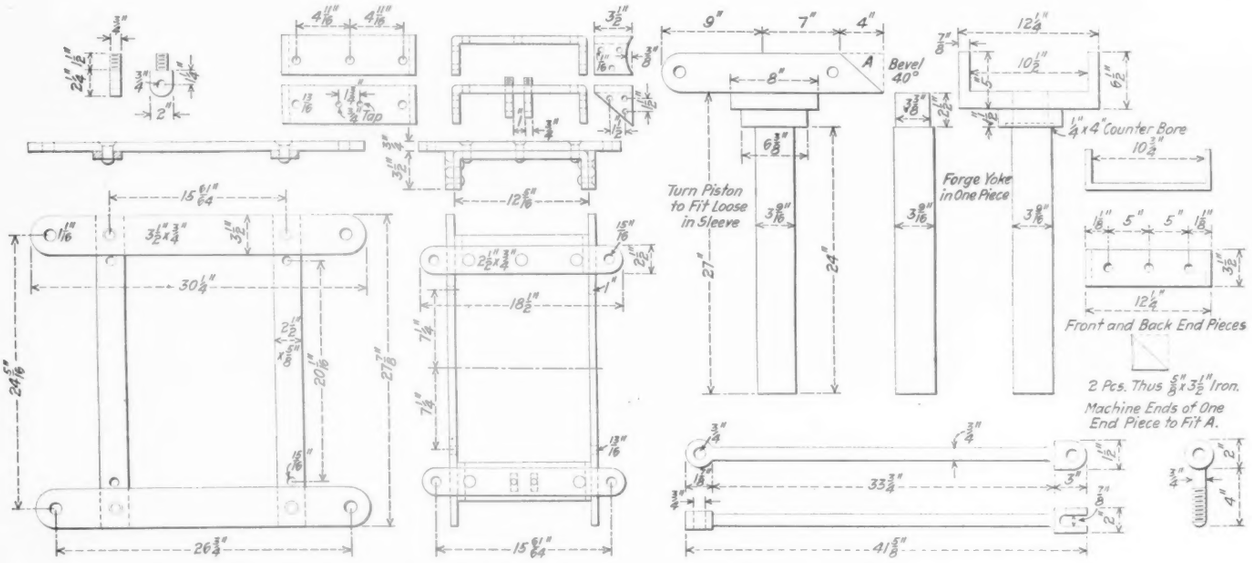

Turn Piston to Fit Loose in Sleeve
Forge Yoke in One Piece
Bevel 40°
1"x4" Counter Bore
Front and Back End Pieces
2 Pcs. Thus ⅝"x3½" Iron.
Machine Ends of One End Piece to Fit A.

Fig. 4—Details of Universal Air Compressor Table

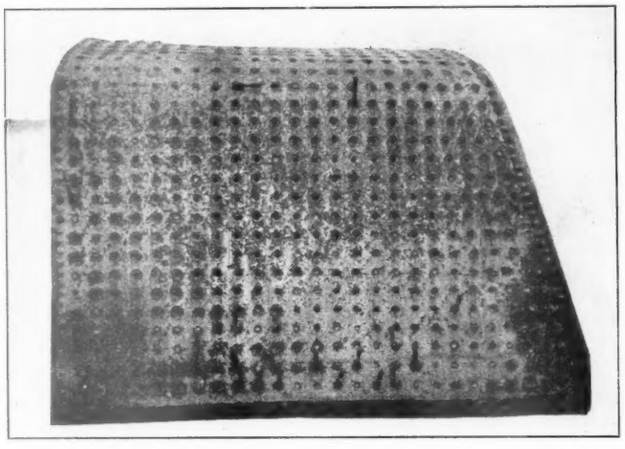
EQUIPMENT NECESSARY FOR ENGINEERING REGIMENTS.—The scope of the work of equipping the regiments of railway engineers now in France is indicated by the cost of materials ordered up to date, which approximates $70,000,000. The equipment so far ordered includes several hundred locomotives, more than 100,000 tons of rails, more than 3,000 complete turnouts, 500,000 ties, 12,000 freight cars, 600 ballast cars and 600 miles of telephone wire and apparatus, as well as large quantities of construction and repair equipment.

BOILER SCALE AND WATER TREATMENT*

Mechanical and Chemical Methods of Preventing Scale Formation and Corrosion from Bad Water

BY GEORGE AUSTIN
General Inspector Boilers, Atchison, Topeka & Santa Fe

FORMATION of mud or salts or both on the water side of the tube sheet of a locomotive boiler covering the copper flue ferrules, a film of slime between the firebox plates and the water, or water in the boiler heavily charged with suspended matter, or scale formation, causes overheating and leaking. It may as well be said at the start that overheating is the principal agent, and other causes are accessory. The first indications of flues and some times other parts being near the leaking point are small light colored beads of sodium salts, mixed with other solids, adhering to the edge of the flue beads. Although flues are tight in the holes, there are small crevices through which the slime works its way and the moisture quickly evaporates on the hot plate, leaving a dry hard deposit, that temporarily plugs up the hole it leaked from. In most cases



Side Sheet Corroded by Bad Water

the engine will make another trip; in some districts it will not do so, without leaking pretty badly or failing. A knowledge of local conditions should and usually does govern the kind of work, if any, to be done on flues, showing those pre-leaking indications. The remedy, of course, is to remove the scale which has formed on the water side. To wait until a leak starts is to wait until some damage is done. Leaks caused by overheating damage the parts affected, nor can repairs be made without further injury, that is, nearly every time flues are worked, their life is shortened. Therefore, on account of overheating causing the necessity for repairs, our energies should be directed to keeping the boiler clean and preventing overheating.

Feed waters heavily charged with incrusting solids will form scale among the flues and staybolts where we cannot get at it to wash it off. We couldn't wash it off if we did get at it; it must be knocked off. Scale forms mostly while the engine is working and at those parts which attain the highest temperatures, probably, because they evaporate more water and a larger quantity of solids are precipitated.

In the case of waters heavily charged with alkalies, the injunction to keep the boilers clean will create a strong sense of the futility of such a remark. Those boilers are clean when they leave the terminal, perhaps freer from mud and scale than boilers on other districts, which give much better performance. The salts from the water being evaporated, precipitate at the points at which evaporation is accomplished. This being nearest to the heating surface, a film of slime grows between the plates and the water causing overheating. That may not be just the right explanation, but, it is not far from it. This slime making water as well as the scale forming water, just spoken of, will always give trouble as long as we let it get into the boilers. Neither case is subject to mechanical improvement, except, so far as adequate facilities may be provided for washing boilers and changing water.

The fillet of scale which forms over the copper ferrule, regardless of its composition, reduces the power of the copper ferrule as a conductor to keep the end of the flue from getting hotter than the flue sheet. It has been suggested that a wider ferrule than is commonly used will require heavier incrustation to impair its efficiency as a conductor and widen the interval between leaks, which reasoning is very plausible.

Scale formation in arch tubes and firebox sheets is indicated first by a sand paper roughness of the parts which are becoming affected, and later by clinker, or as it is sometimes called honeycomb clinging to it. It actually seems as if it was trying to defend itself from injury by establishing a non-conductor of honeycomb on one side to offset the scale formation on the other. The smooth, slightly rounded flatter or bobbing tool in a No. 3 air hammer is effective in most cases in removing this scale. By working on the fire side the jar seems to cause it to flake off. Boilers should be warm when such work is done. There is little danger of cracking the plate by using the methods here mentioned to remove the scale and there is great danger of developing cracks if it is not removed. On some divisions we rattle our fireboxes nearly every month, which is our term for the operation.

We must keep fireboxes clean if we are to get service from them. Clean fireboxes and boilers cut down repairs. Some roads have adopted the system of giving the flues a periodical expanding and claim good results; although we wait for the leaking indications, the same thing is accomplished. The expanding removes the scale and maintains the copper ferrule as a conductor.

SIMMERING LEAKS

By simmering leaks, is meant small leaks in fireboxes that leak continually, but not enough to form a stream and run down the plate and give trouble. These should not be permitted, especially where the water in the boiler is heavily charged with suspended solids. These small simmering leaks are just big enough to let the water through and fine enough to keep back the mud and build up a mud fillet around the flue or staybolt. Overheating is frequently so severe that the flues and staybolts affected become loose in the holes. Many engine failures are due to permitting simmering leaks, especially among the flues. The above class of failure most frequently occurs during seasons when the water is muddy.

Flue performance may be accepted as a barometer indicating firebox performance. If you have no flue troubles,

*From a paper presented before the Western Railway Club.

you have no other boiler trouble. If you have small flue mileage, you have small firebox mileage. If you help the flues, you help the firebox.

KEEPING BOILERS CLEAN

The wash-out appliances including scrapers and search lights used on the Santa Fe were illustrated in the 1915 proceedings of the Master Mechanics Association on pages 398 and 399. (See also Daily Railway Age Gazette, June 12, 1915, page 1296.) We use all the good ideas we can get both as to systems and appliances, which fit our conditions, including hot water boiler washing plants. We wash out locomotive boilers as often as any large railroad in this country, and everything practicable is done to keep boilers clean. Boiler cleaning is a roundhouse job. Dirty, poorly cared for, boilers coming in for general repairs, generally need considerable firebox and boiler repairs, indicating poor looking after in the roundhouse.

TREATING FEED WATER

So far we have dealt with mechanical means of keeping boilers clean, which in certain territories will be found efficient, that is, where the average hardness of the feed water does not exceed six grains per gallon, or road service is not too severe. Excepting perhaps Lake Michigan water I do not know of any water on the Santa Fe, so low in incrusting matter unless accompanied with foaming solids.

Any water treatment that will dissipate the fillets of scale from the flue ferrules or other parts to prevent its formation, is far and away ahead of any mechanical treatment, for the reason that chemical action anticipates and prevents possible damage and affects all parts, while mechanical treatment is deferred and local only, and follows possible damage and fuel losses. It is therefore, evident that we may look for the greatest improvement through water purification or treatment, either by treating the water before it is delivered to the locomotive or in the tank and boiler. If the volume of business on a district is small or the water is not bad enough to justify the expense of water treating plants, during these times it may be very profitable to treat the water in the engine tank. Increases in the demands for power, and cost of labor and material and the greater value of the locomotive, have changed and are still changing values; what would have been considered extravagance yesterday may be good business today. The Santa Fe has road side water treating plants, 125 of them; they use anti-foaming boiler compound, and also, a compound to prevent incrustation and foaming as well. We also use soda ash applied to the locomotive tanks. All water treatment is under the direction of the chief chemist. On some districts the water treatment is supplemented to a limited extent by mechanical means, that is, it is found profitable to a limited extent on some districts to use both chemical and mechanical means. For example, if the staybolts show leakage and inspection shows scale forming, a light pneumatic hammer and bobbing tool are used on bolts and plates in the leaking zone and scale knocked or jarred off. When water treatment creates too much foaming, we may obtain better results by allowing a little scale forming, which may be taken care of by mechanical means. Water treatment may be brought to a point where it is better to allow a little scale than have excessive foaming.

PITTING FLUES AND OTHER CORROSION

The Santa Fe like other roads in bad water districts has to contend with pitting and corrosion. While corrosion of firebox plates has resulted in short life of many fireboxes, flue pitting causes frequent failures and is most annoying on that account. Just what causes pitting and corrosion is not altogether clear. One may advance a theory for a given case and be forced to admit that it does not fit some other. The electrolytic theory seems to be most reasonable when applied to flue pitting, which assumes that there is a positive and negative pole, with an electrolyte or carrier. In proportion as the water increases its soluble salts the efficiency of the carrier or electrolyte increases, therefore, anything tending to diminish the power of either pole, or the carrier between them, will weaken the corrosive action.

The company which furnishes the treatment we use to overcome foaming, claims that it prevents foaming by changing the nature of the soluble salts, and that this change also overcomes the tendency to cause corrosion, by making the salts a less active electrolyte. This claim seems to be borne out by the fact that we have had more trouble from corrosion since

Effect of Corrosion Around Staybolts

adopting superheater engines, which require a smaller quantity of treatment to overcome foaming, or that part of foaming which formerly annoyed the engineer. This is on account of the tendency of the superheater to dry up the water that is carried over. We have had cases where by washing and changing the water frequently engineers have been able to run in bad foaming districts without the use of this treatment. While they considered this a saving to the company, it developed that there was damage from corrosion. We are now using this treatment in sufficient quantities to overcome the foaming tendencies of the water, whether the engineers consider it necessary or not, and find that our trouble from corrosion is diminishing.

It has been observed that passenger engines using anti-foaming compound, pitted more than freight engines on the same district; that superheater passenger engines, in the same service pitted more than saturated engines, and it has been found that when a small quantity of boiler compound is applied when the boiler is washed, or has water changed, and also applied in the engine tanks wherever water is taken, thus keeping the water in the boiler slightly treated at all times, flue pitting has been reduced. We have not had this continuous treatment in operation long enough to know just how much it is helping us, but reports received from points where the system has been carried out, are all favorable.

Referring to corrosion of firebox sheets, two illustrations are shown of fireboxes that have been removed on account of internal corrosion. These pictures were taken about five

years ago and were not uncommon cases at that time. These seem to be plain cases of allowing scale to form at the junction of the stays with the firebox sheets; just a dirty boiler, that's all. If we feel that it is not practical to try and improve these conditions, the conditions have us beaten. If on the other hand, we call to our assistance the chemist and help him to help us, we will without a doubt beat the condition, which was done in these cases.

BLOWING OFF HELPS BOILER CONDITIONS

Any method of water treatment is benefited by the judicious use of the blow off. Short frequent openings, a short time after the locomotive comes to a stop, or just after starting, give the best results. Starting with the beginning of the trip frequently blowing a small quantity of water out at convenient times, when it can be just as well done as not, will keep down the concentration of foaming solids and allow greater mileage between washouts. There are occasionally times when it is necessary to practically change the water in the boiler, but these occasions are usually due to failure to anticipate that condition, or in other words, the blow off was not used soon enough to prevent the water becoming heavily charged with foaming matter. When the water in a boiler becomes so bad as to practically need changing and the engineer wants to give it a good blowing out, do not fill up and then blow out; blow out all that can safely be done first, and then regain the usual supply slowly; if necessary, repeat the operation. Filling up before the blow off is opened simply dilutes the foul water we want to get rid of and wastes the fresh water.

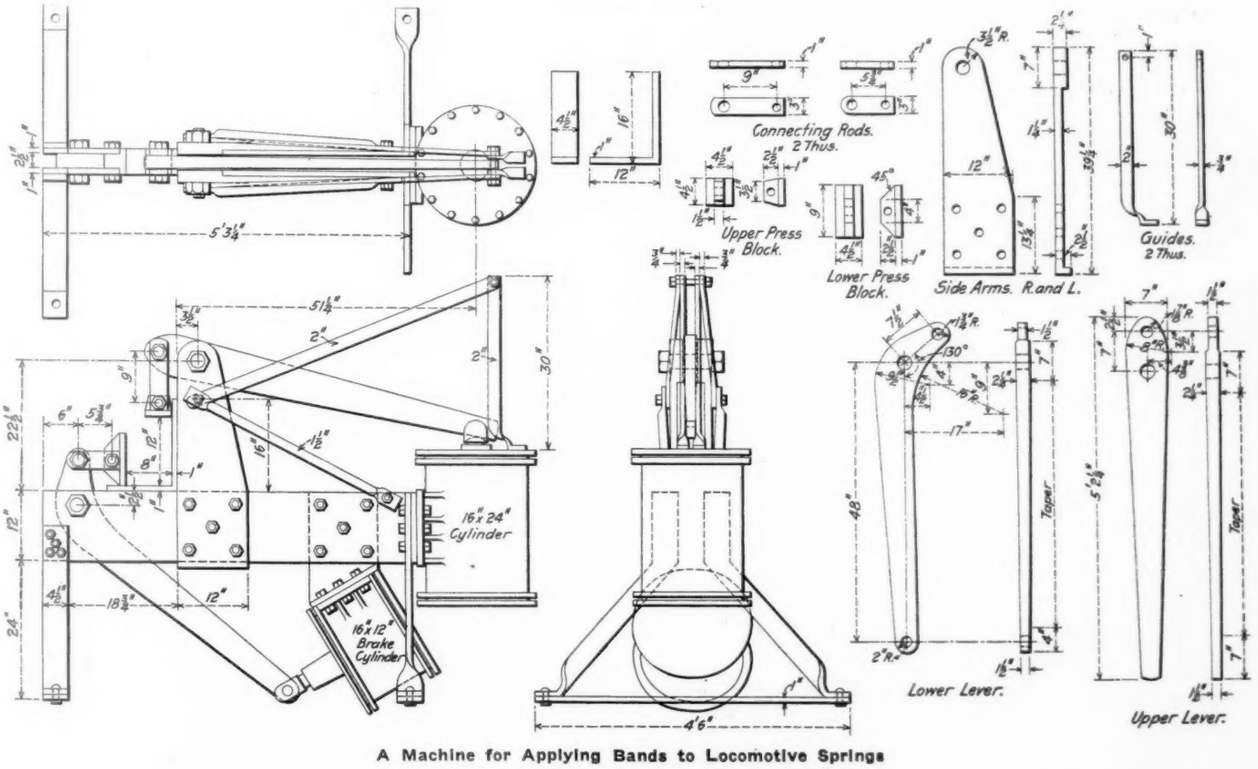
With muddy or roily water not accompanied by foaming, the boiler is greatly benefited by frequent short blow offs, and the possibilities of mud burning and flue and staybolt leakage, cracking and patching on the right than on the left sheet. While it must be admitted, there is a point at which blowing out begins to be a waste of effort, water and fuel, and different districts require different treatment, a generally good rule is to use the blow off freely in all districts where bad water prevails. This brings the engine to the terminal in the best possible condition to be turned. If boiler compound is used, the water should be kept saturated with it, thus reducing pitting and foaming and the liability of running short of water on account of working it out through the cylinders and stack. Foaming will lose more water than need be blown out in a trip to prevent foaming.

Water treatment should be installed wherever practical. Stopping leaks is a poor substitute. The cost of water treatment can be determined, but who can say what its absence may cost in the way of deterioration of boilers and failures and delays of power, incident to poor water conditions? If it seems too expensive to install road side treatment, try treating in the boiler or tender. Encourage the chemists to experiment, stimulate them to develop treatment suited to the conditions. Chemical experiments promise results along the lines of conserving steam boilers which can be expected from no other source.

SPRING BANDING MACHINE

BY J. H. CHANCY

The spring shop of the Georgia Railroad at Augusta, Ga. is equipped with a spring banding machine which has given satisfactory service since its installation and may offer a suggestion to spring shop foremen who are in need of such a device. The illustration shows in plan and elevation



A Machine for Applying Bands to Locomotive Springs

leakage are reduced. The water in the boiler is free from suspended matter, and better circulation and steaming is assured. Blowing out from both sides, should be the rule. When, as is often the case, more blowing is done from the left than the right side, the effects are shown by more staybolt

how the spring bander is constructed. The machine was made from scrap and second hand material found around the shop and the total cost was $216 including labor and what little material had to be obtained from the storeroom.

As shown, the two cylinders are firmly bolted to a rigid

frame which is supported by braces from the floor. The fulcrum pins are large and case-hardened to give greater wearing qualities. The ratio of the long to the short lever arm is such that with 90 lb. air pressure in the cylinders, a powerful leverage is secured.

The operation of the machine, as will be readily understood from the drawing, consists in placing the spring sheaves encircled by a red hot spring band, between the jaws and turning on the air pressure to the vertical cylinder. This operates through the fulcrum and lever to compress the sheaves and when air pressure is applied to the other cylinder, the spring band is compressed and upset, so that when it cools, the band contracts and holds the sheaves firmly in place.

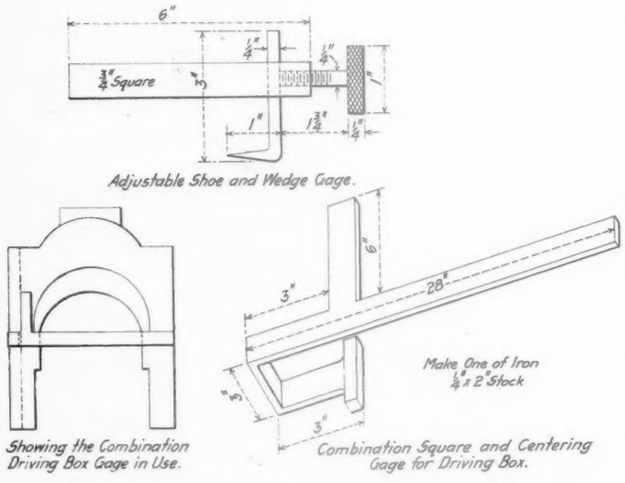
On account of the big leverage available in this machine, it is also adaptable to doing many other jobs which occur in blacksmith shop practice.

GAGES FOR DRIVING BOX WORK

BY J. H. HAHN

In a locomotive repair shop where large numbers of new driving boxes are laid out at a time preparatory to being machined, the combination square and centering gage shown in the illustration will be found a convenient tool. It is made of ¼-in. by 2-in. stock, cut and bent to the shape shown. The 6-in. arm is at right angles to the long arm and the extension that bears on the shoe and wedge face of the driving box has been lengthened so as to maintain the gage at right angles with the center line of the box. With the gage in place a line scribed on the left side of the 6-in. arm will reproduce the shoe and wedge face on the face of the box. It is then easy to lay out the driving box for slotting, or to center a bar for the boring out of the crown brass.

A 2-ft. square and a centering gage would ordinarily be



Two Gages Used in the Norfolk & Western Shops at Bluefield, W. Va.

necessary in laying out a driving box and the combination of these two tools in one eliminates many false moves and results in a considerable saving of time. The tool has proved its value in the Norfolk & Western shops at Bluefield, W. Va., where it was first introduced.

ADJUSTABLE SHOE AND WEDGE GAGE

The adjustable shoe and wedge gage illustrated, while comparatively simple in construction, has been a good time saver in laying out driving box shoes and wedges preparatory to lining the engine. Very often one engine frame will be a little ahead of the other, due to contraction of frame welds or other causes, and in that case it often becomes necessary to machine the shoes and wedges either over or under the standard thickness (1 in.). The adjustable gage then comes in very handy for checking up the work and proving that the shoe or wedge has been accurately planed down to the marks.

As illustrated, the gage is made of a piece of ¾-in. square stock, 6 in. long, drilled and tapped at one end to take a ¼-in. knurled thumb screw. This thumb screw holds the scriber which is bent, hardened and ground to a point at one end and is adjustable in or out.

PRINCIPLES OF THE GENERATION AND APPLICATION OF HEAT IN STEEL TREATING*

BY A. F. MAC FARLAND†

The primary considerations in the heat treatment of steel are the generation of heat and its subsequent application to the metal undergoing treatment. Discussion of such a large subject is something of a problem because so many important points have to be considered and it has been deemed expedient to deal only with the fundamental principles involved, as exemplified in some of the methods in use at the present time.

Ideal heat treating conditions would be realized if we were able to transmit simultaneously to each molecule of steel a certain given amount of heat in a certain given time. This, however, in practice is not attainable for reasons that appear obvious upon consideration of the inherent properties of steel, particularly its specific conductivity. As an illustration of the ideal situation, assuming that we have a solid sphere of steel suspended by some means in a hollow spherical muffle which is heated uniformly all over, the ideal is approached, obviously, as the size of the steel sphere decreases. In an effort to approach as nearly as possible to the ideal in heat treating, fuel and furnace engineers have brought out a vast number of burners and furnaces of various types and designs, many of which are on the market at the present time.

In industrial heating there is no general agreement as to what to use as a heating element and what sort of furnace to use it in. No single type of furnace, fuel or system is applicable to all problems. Quality of product and cost of manufacture are the basis on which the selection of the method of heat treatment should be determined. Obviously, it would not be feasible from a practical standpoint to treat 18-lb. high explosive shells in small electric furnaces, nor would it be advisable to treat small steel balls in a gas furnace with a 6-ft. by 4-ft. hearth. Each class of work calls for its own special arrangement for heat treating, hence we have such a great variety in furnace design and methods of heat generation.

A table of fuels commonly used for heat treating, with their relative heating values and costs, is given below. Electricity has been classed here as a fuel, inasmuch as this paper deals with it primarily as a means of heat generation. The figures for fuel oil, city gas and electricity are based on recent prices; however, it is not desired that any of these computations be taken authoritatively, for in these days of fluctuating prices the computations of today are entirely upset by tomorrow's quotations.

A great many mistakes have been made in selecting a fuel from a table of this nature. It is true that these figures

*Abstract of a paper read before the Chicago Section of the Steel Treating Research Society, January 14, 1918, by A. F. MacFarland, metallurgist, U. S. Ball Bearing Manufacturing Company.

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represent accurately the calorific value of fuels, determined by careful experiment in the laboratory. However, the actual calorific power obtained in practice depends entirely upon the method of burning the fuel. For example, the old style oil burner of the forge shop will not give the calorific value from one gallon of oil that the recently perfected

THE RELATIVE HEATING VALUES, COSTS AND BUYING POWER OF ONE CENT IN B.T.U. FOR FUELS USED IN HEAT TREATING, INCLUDING ELECTRICITY.

	Price basis	B.t.u. basis	Number of B.t.u. for one cent
Electricity	.01 per kw. hr.	3,412	3,412
Gas—			
City gas.....	.75 per 1,000 cu. ft.	600	8,000
Natural gas.....	.50 per 1,000 cu. ft.	950	19,000
Producer gas....	.10 per 1,000 cu. ft.	145	14,500
Oil—			
Crude	.075 per gal.	146,000	19,466
Kerosene	.140 per gal.	132,000	9,420
Coal—			
Bituminous	9.50 per ton	14,000	20,473

vaporizing system for burning oil will give. Oil bills have been cut in half by replacing the old style burners with this improved system.

The means used for the generation of heat also bears an important relation to the quality of the product. A fuel which carries a considerable percentage of sulphur has a deleterious effect on steel when the products of combustion come in contact with the metal. Oxidizing atmospheres in the furnace cause excessive scaling and sometimes troublesome decarbonization of steel surfaces. The ease with which furnace atmospheres are able to be maintained depends largely upon the flexibility of the medium of heat generation. By flexibility is meant the ease with which the fuel lends itself to producing either oxidizing or reducing atmospheres in the furnace. Gas and oil are more easily controlled in this respect than coal or coke, depending somewhat on the facilities for burning them, while electricity is an ideal heating medium for producing neutral atmospheres. In hardening a number of small parts a short time ago in an electric furnace and quenching them from 1,500 deg. F., not one showed the least sign of scale or oxidation. An investigation of the matter showed that a new piece of insulating brick placed in the furnace was responsible for the phenomenon as it contained a substance which produced a strongly reducing atmosphere in the furnace. This phenomenon should prove of interest to a manufacturer who is treating parts where even the thinnest scale is undesirable.

The cheapest fuel, on a strictly B.t.u. or calorific basis, is not often the cheapest fuel for heat treating steel, when all the factors which have a distinct influence on the subject are taken into consideration. There is always a right fuel for the particular heat treating operation at hand, and each problem should be thoroughly studied and understood if the best solution is to be had. In heat generation and application, the human element plays a very important part. The manufacturer who invests in expensive furnaces and fuel equipment makes a grave mistake if he fails at the same time to invest in a suitable amount of brains to operate this equipment for him efficiently. Fool-proof heat-treating equipment is still a thing of the future, although considerable progress along the lines of automatic temperature control has been made, resulting in various appliances which tend to minimize the difficulties encountered, especially on very large installations, where uniformity is as important as the enormous production.

Furnace builders up to the past few years, with a few possible exceptions, seem to have been in a dormant state. While pyrometry, metallography and other related branches of steel treatment were making rapid progress, it is not until comparatively recent years that furnace men have been awakened to the crying need of better furnaces. With this awakening has come the electric furnace, new systems for burning oil, gas and coal and the basing of recent furnace design on sound scientific principles.

Electric furnaces used in commercial heat treating may be roughly classed under two heads:

1. Wire-wound furnaces, where the resistance material consists of wire, usually composed of an alloy of nickel and chromium, and useful for temperatures up to about 1,800 deg. F. These furnaces range in size from small laboratory furnaces to muffle furnaces with chamber dimensions of 24 in. by 24 in. by 48 in.

2. Carbon resistance furnaces where the resistance material is carbon. Small furnaces of this type may be used for relatively high temperatures and are suitable for treating high speed steel and even for melting a quantity of brass. The construction of wire-wound furnaces, is very simple if the necessary materials are at hand, and they afford the nearest approach to ideal heating conditions. This is especially true where the work is suspended, and receives heat from all sides, both by radiation and by conduction through the atmosphere.

Gas and oil furnaces are, perhaps, the most widely used for commercial heat treatment, and on account of lack of time only a few of the many possible designs will be commented upon.

In the case of the simple underfired furnace which is being used at the present time for a large number of heat-treating operations, the combustion takes place below the hearth and the hot gases pass around the sides of the hearth into the heating chamber. Obviously, the edges of the hearth will heat first, and any stock placed in the furnace near the edge of the hearth will heat locally in the place which is nearest the edge. This can be overcome to some extent by building up the sides of the hearth. This arrangement also stops any overloading at the sides of the furnace and tends to prevent cutting action of the gases near the hearth line. There is no need to build these sides beyond a certain height, for once properly guided, the hot gases by nature will continue in an upward direction to the roof of the furnace. The location of the vents in a furnace is important and they should not be put in the roof, where they will allow the hot gases to escape and be wasted. Certain efficient types of furnaces are designed to use the exhaust gases in preheating the air before it goes to the combustion chamber.

In connection with furnace design, mention of furnace capacity and overloading is opportune. In no case should a furnace be loaded full with carbonizing boxes, for instance, that rest directly on the hearth and are closely packed together. It is necessary that space be left for the free circulation of the hot gases or the charge will not be uniformly heated.

Over-fired furnaces have many adherents, but as a rule they are adaptable only to low charges. When the charges are high there is a tendency to overheat the top, and this feature, combined with a cold hearth, make uniform heating practically impossible. The advantage of this type of furnace is the ease with which the material to be heated may be handled.

It is unnecessary to go into the design of coal-fired furnaces because of the fact that they are being rapidly replaced by equipment using oil or gas. However, powdered coal could probably be used to distinct advantage in some heat-treating operations, and the field for the use of this fuel is being rapidly extended, due to its decreasing cost.

In regard to forging furnaces, it seems to be a prevalent idea that any manner of heating device will suffice to bring steel to the proper temperature for forging, but on the contrary too much care cannot be taken in the furnace design. "Dupping" heats as well as "soaking" heats are equally to be

avoided, and the furnaces must be designed to give a uniform heat throughout the stock.

In conclusion it is perhaps wise to re-emphasize the importance of heat treatment of steel and to urge a continual study of the subject.

RAILWAY SHOP FANS AND BLOWERS

BY J. H. WICKMAN

The increasing use of blower and suction fans for different classes of work around railway repair shops, makes it imperative that there should be a better understanding of the requirements for a successful blower installation. Too often, although the purchaser knows exactly what work he wants the blower to do, he has not the engineering knowledge necessary to figure out what size of machine will be required to do it and how much power it will take. In this case the specifications are usually left to the manufacturer, who guarantees to supply a certain amount of air at a specified pressure, and is not so much interested in the efficiency of the installation as a whole.

There are a number of items to consider before ordering a new blower, and, as stated before, it is usually better, on account of a more intimate knowledge of what is needed for the purchaser to solve his own problem. The purchaser should consider in detail the requirements of the service the fan is to perform, and in making his order be able to specify the size of fan, rating of the motor, the amount of air pressure and the volume required, the speed, pulley sizes, etc.

As to determining just what the specifications shall be in a particular case, undoubtedly the best method is to study an existing installation with similar characteristics. As an example, suppose a new blower installation is to be put in for the purpose of conveying shavings away from the mill room machinery. What size of motor, fan, pulleys, etc., will be required? What is the requisite speed and air pressure? A careful study and possibly a test of a blower already in operation under similar conditions and working satisfactorily will give the data on which to base specifications. Speeds may be taken by speed indicators or revolution counters, and the pulley diameters may be measured. Air pressures may be taken by means of the familiar U tube, and power intake may be measured by electric meters. In case the existing installation was not entirely satisfactory and did not produce enough pressure to carry off the shavings and refuse, it would be advisable to speed it up and take data when it was operating satisfactorily. This can always be done by changing the size of pulleys for a short period of time while taking the readings.

The air pressure will be found to vary as the square of the velocity; that is, if the pressure is to be doubled, the velocity must be increased four times. In order to illustrate, consider the following simple problem: If a fan produces one ounce air pressure at 2,800 r.p.m., what pressure will be obtained by speeding up the blower to 4,000 r.p.m.? When stated in the form of a proportion the rule set forth becomes:

$$1 : X :: 2{,}800^2 : 4{,}000^2$$

$$X = \frac{4{,}000^2}{2{,}800^2} = \frac{100}{49}$$

$X = 2.04$ ounces of air pressure at a speed of 4,000 r.p.m.

In regard to the power required to drive the fan or blower when speeded up, it will be found to vary as the cube of the velocity—that is, if the velocity is doubled the power required will be increased eight times. This rule may be illustrated by the following problem: If a blower revolving at 2,800 r.p.m. requires 35 hp. to drive it, how much would be required at 4,000 r.p.m. Let X equal the required power and express the above rule in the form of a proportion:

$$35 : X :: 2{,}800^3 : 4{,}000^3$$

$$X = 35 \times \frac{4{,}000^3}{2{,}800^3}$$

$$= \frac{35 \times 1{,}000}{343}$$

$$= 102 \text{ hp.}$$

In conclusion it may be stated that while the above method of figuring on a blower installation may not be strictly scientific and according to the best engineering standards, it will give quick and reasonably accurate results.

POLISHING ASH PANS IN FRANCE

FROM A LIEUTENANT OF THE SHOP REGIMENTS

I have just been reading the August number of the *Railway Mechanical Engineer* and have showed it to the French railroad officers. They were particularly interested, but their point of view is so different from ours that it is almost impossible to make any comparisons of work or methods in the shop. While they do waste a lot of energy in polishing up the ashpan and putting "inlaid patching" on the bumper beam, they finally end up by turning out a locomotive that is right and will stay right for a long time.

The French workmen start work at 6:00 a. m. or rather about 6:15 and do about three hours' work between 6 and 12. At 12 they start to go home, or rather they start to go home at 11:45, and do not return until 2:00 p. m. Work starts at 2:10 p. m. and continues until about 7 p. m. Altogether about five hours of work in a really good shop is all they do in the entire day, but they do it right. The ashpan is just as carefully fitted up as the valves.

At first I could not understand how they set the valves, but finally discovered that the valve motion was so carefully fitted up in the machine shop that it was not necessary to make adjustments after it was applied to the locomotive.

The adjustable type of wedge which we use in America made quite a hit with the French officers, but many of the large engines here do not have wedges—the box is pretty tight fit in the jaw and they claim there is only one millimetre wear in the jaw each year. It sounds a bit fishy to me, but I am no longer surprised at anything.

These locomotives are in splendid condition—they run as smooth as an eight-cylinder automobile—not a pound anywhere.

The title "engineer" over here covers a multitude of sins—an engineer wanders about and looks wise, if possible—so far as I can discover, he never by any chance does any work except to discuss technical subjects from the purely scientific standpoint without arriving at any conclusion. Perhaps I shall revise all my opinions next week, so I'll go no farther with them now.

I can now speak very much better French than when I first arrived and hope to be proficient in a couple of months. The French people are very much pleased because our boys all started in at once to learn French. The British make very little effort in that direction, and the French have noticed it.

From all indications the railroad shops are to all effects and purposes strongly unionized. I am amazed that the French army, which is a very efficient machine, has not taken over the railroads also. The French workmen go at exactly the same pace as in peace time and they spend just as much time in polishing the ashpan and putting inlaid patches on the bumper beam as they ever did. In this little shop there is enough copper and brass to supply a whole railroad.

SOME INTERESTING BOILER SHOP EQUIPMENT

BY F. W. SEELERT

The machines illustrated in this article were built several years ago at the Shoreham shops of the Soo Line and have proved to be entirely practicable and economical, both in operation and in upkeep. The hydraulic superheater flue tester, Figs. 1, 2 and 3, was designed by

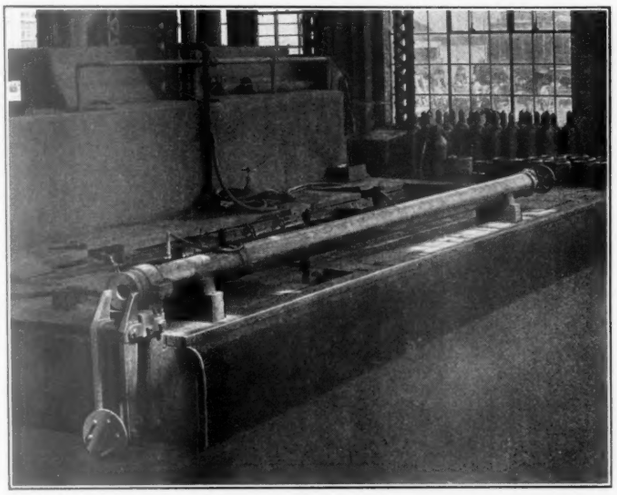


Fig. 1—Hydraulic Superheater Flue Tester

the boiler shop foreman, Martin Sobraske, who has a patent pending on it. The outstanding feature of this machine is the testing of flues under actual working conditions by having the pressure applied from the outside. Fig. 1 shows the general appearance of the tester, which is mounted on the concrete retaining wall of the flue rattler. The front end from which the flues are entered is shown more in detail in Fig. 2, and Fig. 3 shows the rear or piston end of the machine with the adjusting screw and wheel.

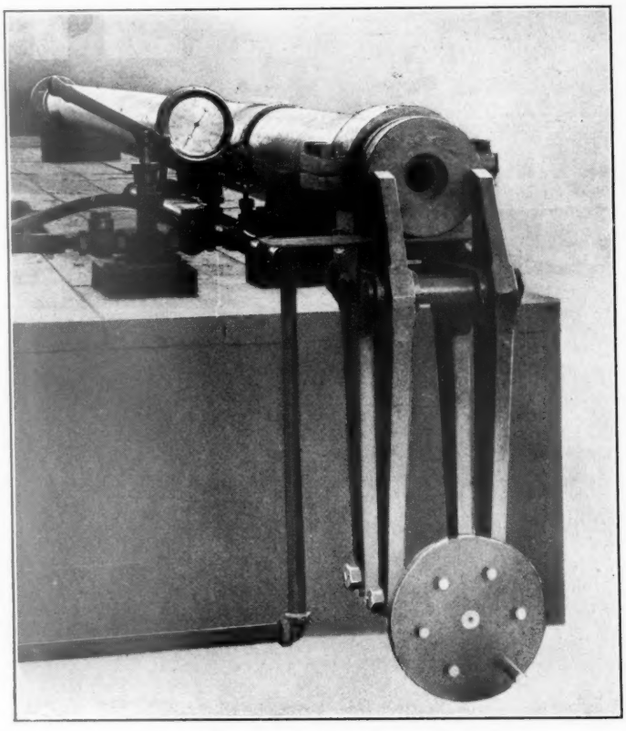


Fig. 2—Showing Front End of Flue Tester

The cylinder is a 7-in. double extra heavy pipe 23 ft. 6 in. long, the inside of which is bored out to 7¼ in. diameter for a length of about 12 ft. from the back end toward the center, in order to provide a good finished surface for the hydraulic leather packed piston. The front end of the cylinder is closed by a removable cap, which is tightened by a substantial clamp arrangement operated by a screw and hand-wheel. The details of this design are shown in Fig. 2. The piston in the back end of the cylinder can be fitted to extension pipes of suitable lengths, so as to take care of flues from 12 ft. to 23 ft. in length. The ends of the flue and also the front end of the cylinder are sealed watertight by means of hard rubber rings inserted in the cylinder cap and the piston respectively.

In operating the machine a flue is placed in the cylinder and properly tightened up, the space around it being filled with water by simply opening the cock shown on top of the cylinder in Fig. 2. After the cylinder is filled, the pressure is raised by the little hand pump shown at the left in Fig. 2. A few strokes are sufficient to give a pressure of 450 lb. or 500 lb. and the flues are then inspected through the opening in the front cylinder cap. An electric light bulb,

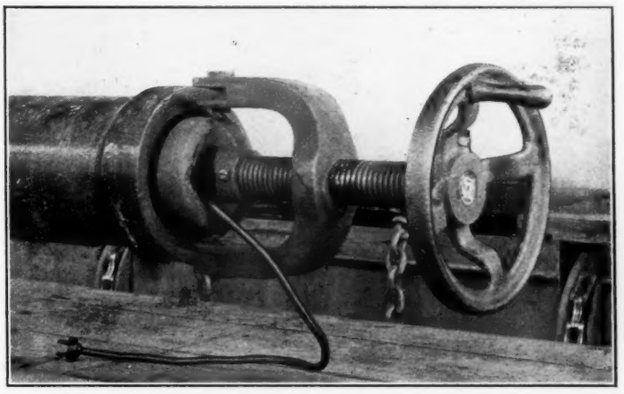


Fig. 3—Back End of Flue Tester

fastened in a similar opening in the piston on the other end of the flue, provides proper illumination for the inspection and any leak will be readily detected. This machine gives an accurate test for flue defects due to unsound welds, pit marks, etc., and it paid for itself in a short time. A set of flues when put into a boiler without being tested usually contains one or more that leak due to defective welds and the cost of removing and replacing one leaky flue in a boiler is greater than the cost of testing the whole set in the machine described.

SUPERHEATER FLUE SWAGER

A very compact and well designed pneumatic swager for superheater flues is illustrated in Figs. 4 and 5. The frame of this machine is built up of two 10-in. channels connected by suitable angle irons and straps, the upper part containing an 8-in. freight car brake cylinder. The cylinder is fitted with a piston whose stem, 2½-in. in diameter, passes downward through the lower head. Around the stem there is a heavy compression spring acting on the lower face of the piston and the lower end of the piston rod carries a follower for the upper die. This acts as a ram for the swaging process. The dies are forged solid from steel locomotive axles. As originally designed, it was necessary for the operator to step on a foot treadle for every stroke of the piston, and to eliminate this, the swager was equipped with the automatic valve shown in Fig. 5. A 1½-in. three-way

cock carrying a two-arm tappet is cut into the feed pipe and this tappet is acted upon to operate the valve by an arm pivoted on the frame and connected with the upper die. As the latter rises and falls, the outer end of the arm is rocked slightly in the opposite direction and operates the three-way cock. The points of contact of the end of the arm and the tappet consist of hardened steel spring plungers to eliminate wear. The machine operates at about 300 strokes per minute and has given hardly any trouble since its installation about three years ago.

RADIAL STAYBOLT CUTTER

The special bolt cutter illustrated in Fig. 6 was designed for turning and cutting the taper thread under the button head of a radial staybolt. This machine was originally a 1½-in. double head bolt cutter of standard design and was rebuilt by the writer for the purpose mentioned. As can be

Fig. 4—Superheater Flue Swager

seen from the illustration, each spindle is provided with a reversible gear and a clutch drive mounted on a steel plate superstructure. The die heads are arranged to be opened by hand by the lever at the side of each head. The top end of the staybolt is guided by an interchangeable sleeve in the spindle. Four of these sleeves are provided to take care of all sizes of staybolts from 1⅛-in. to 1⅜-in. and of any length. One end of the sleeve has a plain hole and the other end a threaded hole of the respective size of the bolt to be guided. The die heads used are known as the Cook die head, manufactured by the Detrick & Harvey Company, Baltimore, Md. This type of head is particularly adapted for the work. The left hand head is equipped with plain cutters which convert it practically into a hollow mill or box tool. The right hand head contains the threading dies. The automatic knock off on the die heads is not used, because the recess under the button head of the bolt is cup shaped and would not permit opening the ties before the bolt is backed out a little distance. This is the reason for the reversible drive.

In operating the machine the bolt is placed in the floating holder shown in the left hand vise in Fig. 6. The top end of the rough bolt *A*, Fig. 7 is entered in the guide sleeve in the spindle; the die head is closed and the bolt is fed

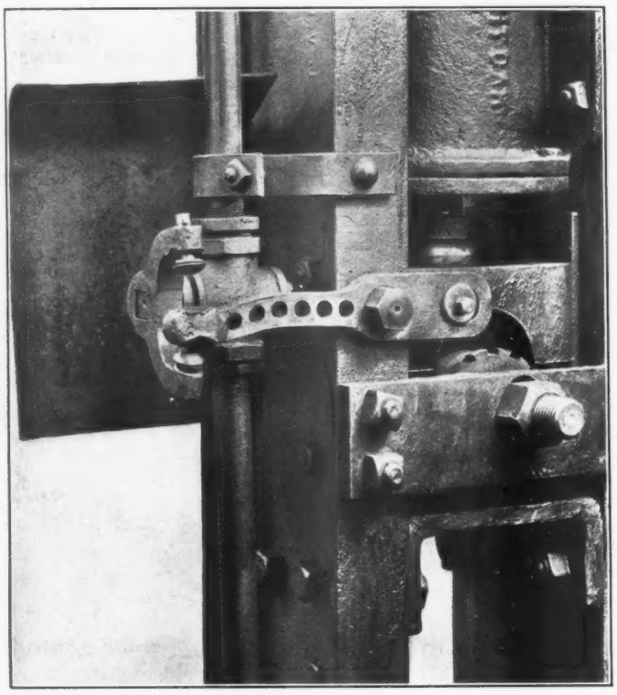


Fig. 5—Automatic Valve Used with Flue Swager

into the proper depth by hand. After this operation, the bolt looks like *B*, Fig. 7. Next the bolt is placed in the right hand head in the same manner. The guide sleeve in this spindle is threaded and can be adjusted so as to bring the threads on both ends of the bolt in correct lead. The

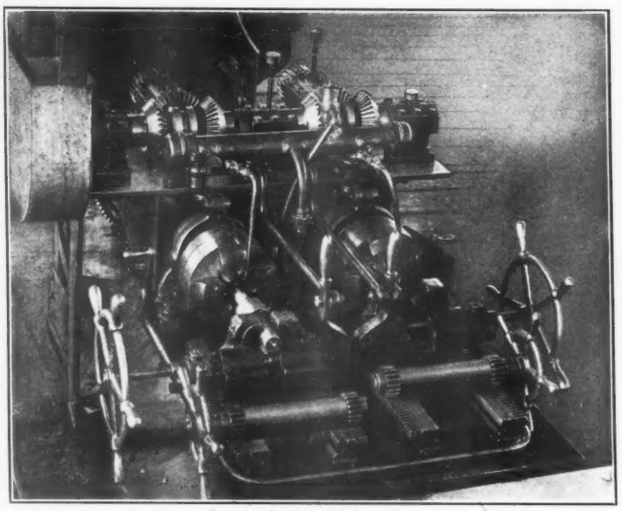


Fig. 6—Radial Staybolt Cutter

clutch on the right hand die head is adjusted to slip before any damage can be done to the threading dies, in case the operator should run the die up against the shoulder of the bolt head. Before opening the die head the machine

is reversed for about ¼ in. so the dies clear the cupped shoulder of the button head. After this the bolt appears as shown at *C*, Fig. 7.

Originally these bolts were turned and threaded entirely on the engine lathe. Sometimes, on rush jobs, four or five

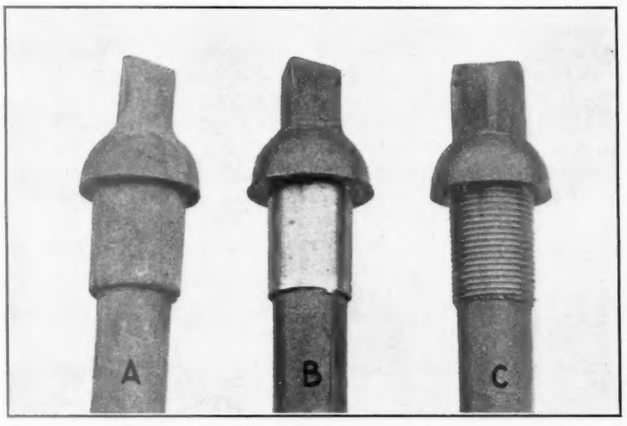


Fig. 7—Radial Staybolts Before and After Machining

lathes were working on radial staybolts, and with this method of manufacture they cost about 15 cents each. With this bolt cutter the cost per bolt has been reduced to about two cents per bolt. Furthermore, the work on the bolts is now done entirely in the boiler shop under the supervision of the boiler shop foreman and a lot of unnecessary handling has been eliminated. This machine is convenient to operate and has given excellent service for over three years.

SOMETHING NEW IN REAMERS

A new method of making inserted-tooth, high-speed steel reamers and milling cutters was described by T. O. Martin, blacksmith foreman, Illinois Central, Jackson, Tenn., in a recent issue of Reactions, and it is very timely on account of the present prices of high-speed steel. The helical reamer described in this article, and illustrated in Fig. 1, was made of high-speed steel blades welded into a Thermit steel body, and the cost was $15.25 as against $68.45, the lowest quotation of a machine tool manufacturer for a reamer of the

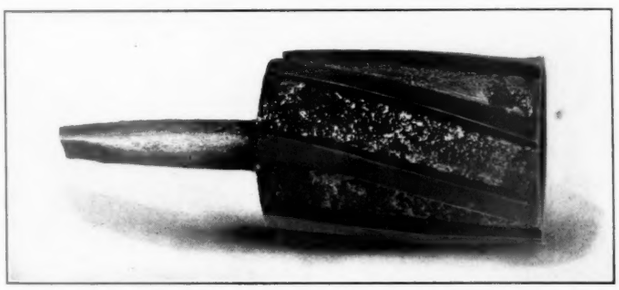


Fig. 1—A Helical Reamer Made of Thermit Steel and High Speed Blades

same size and kind. This reamer has been in service at the Jackson shops for about a year, and so far has proved an efficient tool.

In making a reamer by the Thermit steel process, first make the blades from high-speed steel of helical shape to conform to the required length and pitch of the reamer. Then bore out a cylinder with the same size and taper of reamer which it is desired to reproduce. Set the blades up in this cylinder, spacing them properly, with the cutting edges firmly against the cylinder wall and leaving sufficient clearance behind the cutting edges of the blades. Then place a carbon steel core in the center. The carbon steel core is machined at one end to fit a Morse taper socket. Fill the space between the core and the cylinder with molten beeswax and allow it to cool. Then remove the contents of the cylinder intact; that is, the beeswax body, iron core and cutter blades. This can be accomplished very easily by heating the outside of the cylinder, thus expanding it and melting the outside surface of the wax so that it can be slipped out without

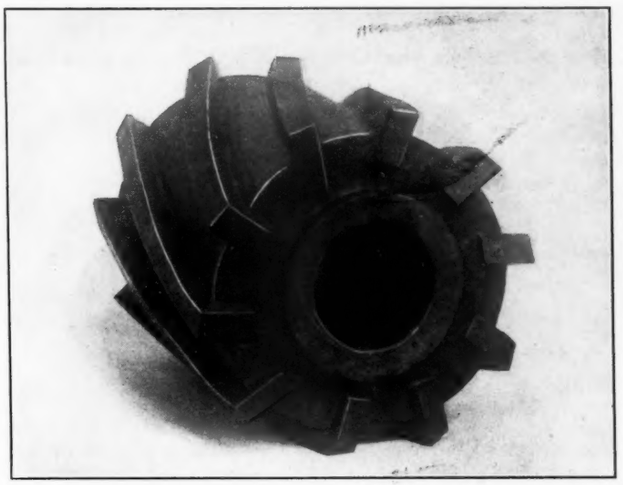


Fig. 2—Reamer Blades Inserted in Wax and Ready for the Mould

trouble. The next step in the operation is to trim the wax between the blades as shown in Fig. 2. This matrix is then ready to be placed in a regular mould for Thermit welding, as shown in Fig. 3.

In moulding, the reamer is placed upside down in the

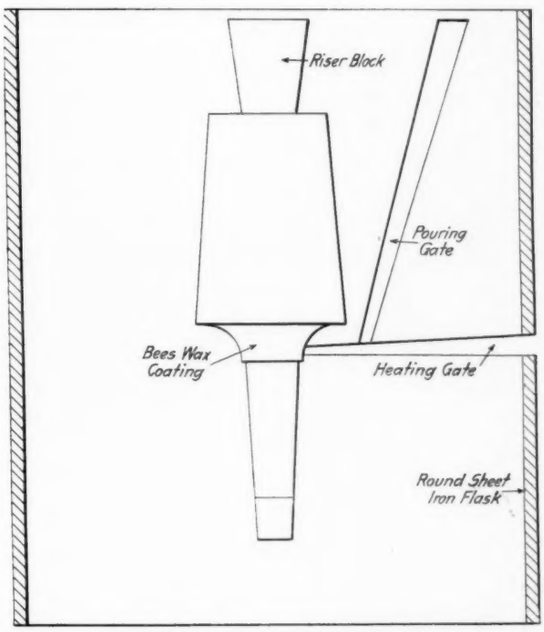


Fig. 3—Set Up of Mould Before Pouring

box and the moulding material is rammed to within about 1½ in. of the blades. At this point the heating gate is directed against the carbon steel core, with the pouring gate left about 3 in. away from the side of the core, as shown.

The mould is then rammed up, the same as in the case of a broken locomotive frame. When the mould is filled up to the top of the reamer, a wooden riser is put in place, which will permit of a free flow of the moulten Thermit steel into the mould.

Heat up the mould with a preheater to a good white heat (this also melts out the wax), and plug up the heating gate. Then ignite the Thermit, and, after the reaction has taken place, tap the crucible. It is usually safe to knock down the mould in about one-half hour, and cut off the riser with an oxy-acetylene cutting torch.

Contrary to expectations, it has been found that the intense heat of the Thermit reaction actually improves the quality of the inserted blades, and no subsequent heat treatment is necessary. This may not appear reasonable, but it is perhaps explained by the fact that all air is excluded from the mould.

The reamer shown in Fig. 1 was made in practically the same time as would be required to weld a locomotive frame, and, as stated before, has given good service for a considerable time. In addition to reducing the cost, the above method of making high-speed steel tools possesses the added advantage that it is possible to obtain them at any time when desired.

GROUP INSURANCE

BY A. J. SCHNEIDER

The ever-growing serious problem of labor turnover is caused largely by the high prices which munition concerns are able to pay for all kinds of work. But whatever the cause of the problem, its solution is equally necessary to railroads, supply firms and all old-established companies. Something must be done to hold the older employees on the job.

Of the methods by which it is proposed to decrease the labor turnover, one of the most promising is group insurance, and this plan is being tried out by the Cincinnati Planer Company. This plan was put into effect on October 4, 1917, and while it is too soon to prophesy its success or failure, certain results are already noticeable. There is a considerable increase in the applications to the employment department. Group insurance affords a good talking point for the employment manager, the superintendent, the foreman, etc.

The actual insurance, of course, is provided by insurance companies, and the average cost is $4 per year per employee (less than two cents per day), depending on age and length of service. In view of the small cost, the plan is almost sure to pay for itself.

In placing the plan before the employees, a letter typewritten on the regular company letterhead and made as short and plain as possible was sent directly from the manager to the home. It was hoped in this way to cause a wider discussion and make the employee feel that the company had a personal interest in him.

The letter pointed out that employees needed insurance for the protection of their dependents and went on to say that those who had been in the constant employ of the company for three months were to be insured by the company for $500, six months for $600, one year $700, and $100 additional insurance each year until a maximum amount of $1,500 had been reached. The insurance was made retroactive, and employees were credited with the amount of insuranc to which they were entitled by the above plan. The letter stated that the action was entirely voluntary, and that it constituted no contract to the employee and conferred no legal right on him. In other words, it did not change the employee's right to leave, nor the employer's right to dismiss him from the service of the company.

All of these benefits were provided at the expense of the Cincinnati Planer Company, no deductions from wages or contributions of any kind being required from the employees, and all rights or benefits ceased whenever the employee left or was dismissed from the service. In addition to offering life insurance protection, the contract provided an income in case of permanent disability, whether resulting from disease or accident.

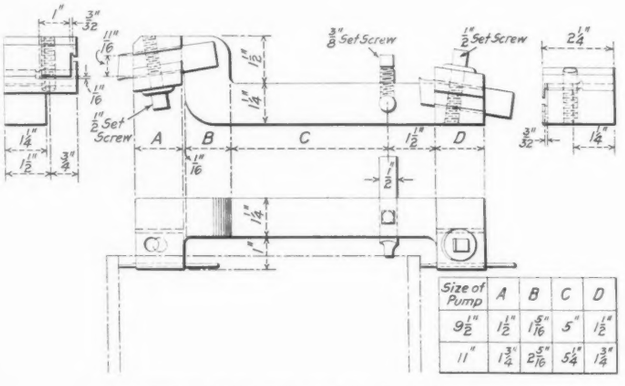
One part of the proposition which received considerable study was the question of whether the insurance should be based on wages or length of service. It was decided that the latter plan was the simpler and more efficient for several reasons. In the first place, it was felt that group insurance would be adopted by many employers in the near future, and if the plan was based on wages there would be nothing to hold the employees. In other words, if two shops in the same locality both had insurance based on income, an employee insured for $1,000 would have no incentive for remaining with the old organization if he could get the same or better wages in the new shop. Therefore, it was considered best to base the insurance on length of service, which has the additional advantage of being very simple and reduces the mechanical work involved.

The work required in connection with the plan of group insurance requires very little time, and consists of a record card giving the name of the company, employee, birthday, address, beneficiary, etc. After this card is filled out, no work is required unless the employee leaves the service or dies, except an occasional checking of invoices and making an occasional report

SPECIAL TOOL FOR TURNING UP AIR PUMP PISTON RINGS

The tool illustrated below is used in the West Burlington (Iowa) shop of the Chicago, Burlington & Quincy for cutting off and facing air pump piston packing rings. Two sizes are in use, one for 9½-in. and the other for 11-in. rings. The tools are attached to the upper head of a 36-in. vertical turret lathe, the relative position of the work and the tools being as shown in the illustration.

The thickness of the rings can be varied by changing the adjustment of the facing tool. By raising or lowering the sides of the holder the upper cutting edges of the inner



Tool Which Cuts Off and Faces Piston Rings.

and outer cutting-off tools can be brought in line. Any variation in the thickness of these tools is taken care of by the light cuts taken across the top with the facing tool. By decreasing the depth of the cut which it is necessary to take with the parting tool, thinner tools can be used, thus reducing the amount of metal wasted. In addition to this, there is a considerable saving in the time required to make the rings.

MAKING COLD CHISELS

BY G. J. BRUNELLE
Assistant Blacksmith Foreman, Boston & Maine, North Billerica, Mass.

There should be no more guesswork in the making of good chisels than in the making of good taps, reamers, milling cutters, etc. In the first place, a suitable steel must be procured, and manufacturers usually carry on hand a special 85 to 95-point carbon steel for this purpose. It is rather coarse grained in the annealed bar, yet capable of refining at the critical point when forged and hardened at the proper heat, and is very tough. It is important to know that carbon, while imparting hardness to steel, also increases its brittleness, and a chisel made of steel with too high a percentage of carbon is dangerous to use.

Should one of the alloy or high-speed steels be selected,

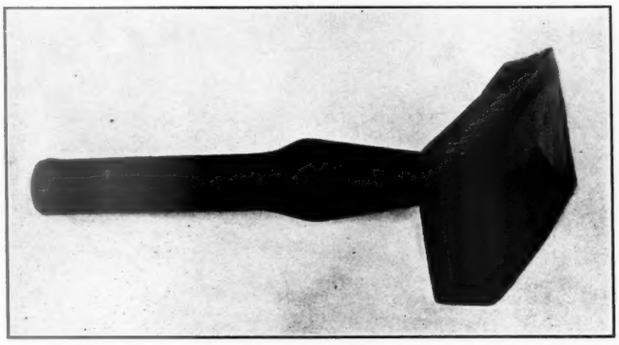


Fig. 1—A 5/16-in. Cape Chisel Driven Through ¾-in. Stock

it must be plainly marked, for the method of treatment is entirely different from that of carbon steel, and the toolmaker should be able to tell at a glance with just what kind of steel he is working.

After securing a good steel, the next requisite is a good toolmaker, and it is a mistake to give the work to a cheap man, novice or apprentice. The excuse is generally made that the job is good practice for beginners, as the chisel is one of the cheapest tools. This is true enough if the chisels are being made to give a man experience, but if they are required for use they should be made by the most experienced workman available, because a man can employ with profit as much skill in making a good chisel as in making a good lathe tool. Good chisels, like those illustrated in Figs. 1 and 2, do not break with fair usage nor require frequent grinding, and are highly prized by good mechanics.

Uniform practice in working the steel is to be desired, and for this purpose printed instructions should be issued. Manufacturers generally are glad to furnish special instructions with each kind of steel, but these neatly printed booklets are too often allowed to lay in the office of the man responsible for the purchase, only to be consulted after a lot of tools have proved defective.

In case no special instructions are given, it is good practice to find, either by heat measuring instruments or by tests, at just what temperature the steel refines in hardening and retains is greatest toughness. This is commonly done by drawing out a test piece to about ½ in. square, making a number of deep cuts ½ in. apart, as shown in Fig. 3. Allow the test piece to cool and reheat to a tapering heat; that is, with section 1 white hot and section 7 a low red. It should then be quenched in oil or water, as the case may be, at a rising heat. Do not heat the test piece higher than is wanted and allow it to cool to the desired temperature. If the heat is unsatisfactory, allow the test piece to cool and try again. When it is heated to the correct temperature, cool suddenly, as described above, and dry. Then break off the sections at the cuts, beginning at section 1, noting at the same time how much pressure is required to break off each section. The first section will break off easily and show a coarse fracture. The next will require more pressure and show a finer grain, and so on, until a section is found that breaks off with difficulty and has very fine grain. This is the model fracture for the hardener to work to on that particular steel. The heat may not be remembered, but the grain of fracture is there to make comparisons by and let the hardener know if he is heating too high or too low.

The general rule is that steel gives best results when hardened at the lowest heat at which it will harden. Referring back to the test piece, it will be found that back of the section showing the finest grain is another that breaks off with great difficulty and yet shows a coarse grain similar to the annealed bar. This section will be found to be soft, showing that the part was not heated to the point of recalescence; that is, the temperature at which steel hardens. Now it often happens that, while trying to keep as near to that low heat as possible, which is absolutely necessary to get good results, a hardener allows his furnace to get just below this point. The result is a lot of soft tools, for which he will be more severely criticised than if he had been careless and had kept his furnace well above the required heat.

The best way to cut the stock for chisels is at the shears, and neither the knives nor the steel will be injured if the bars are first annealed by drawing the material through a furnace or over a fire at about 200 to 250 deg. F. Should this annealing be omitted, the ends are liable to be shattered while being cut and develop flaws.

In forging, a furnace is more to be preferred than an open fire, and the steel should not be held at a high heat too long. On the other hand, the steel must not be worked too cold, for the closer packed the grain of the steel the stronger and tougher it will be. Enough material should be trimmed from the end of the chisel to get rid of any fire or water checks, like those shown in Fig. 4.

The shaping of a chisel is important and certain general

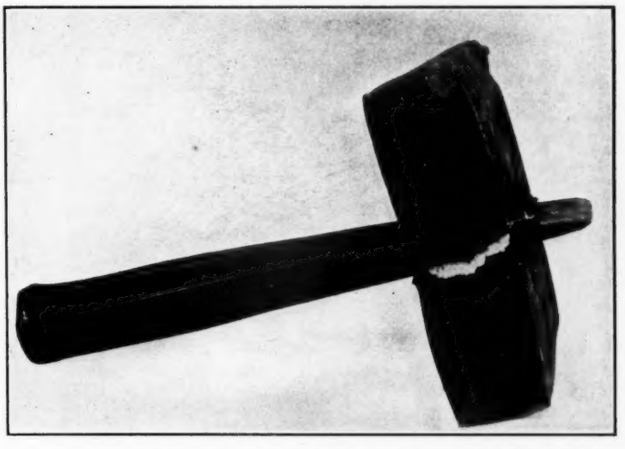


Fig. 2—A One-Inch Flat Chisel Driven Through 1¼-in. Stock

rules apply to all kinds. Each should be forged so that the flat surfaces of the blade are a continuation of the flat surfaces of the stock, and if the chisel is to stand up under hard usage, the cutting edge must be in the center line of the body of the chisel. It is also a mistake to forge a chisel too blunt, as a long tapered chisel having a certain amount of spring will absorb many a shock that would break a thick, blunt cutting edge.

The flat chisel shown in Fig. 4, when made of ⅞-in. octagon stock, should be tapered back about 3½ to 4 in., making an angle of approximately 12 deg. and should flare out slightly at the point, so that the cutting edge will be about

one inch wide. Fig. 5 shows two extra good chisels of this kind (for chipping only), which are made by drawing out the blades about ¼ in. thick and 3½ in. long. To give them the proper stiffness and durability they should be hardened and tempered the whole length of the blade. This permits the use of many short chisels that would otherwise be scrapped.

In making the round nose and cape chisels, illustrated in Fig. 6, two points are to be remembered. It is important to give the cutting edge clearness and to temper the blade at least two inches back from the point.

These are three of the more common shapes, but the same intelligent care required for success with these will produce good results when applied to making larger tools of the same type, such as handle chisels, chisel bars, etc. All chisels, after being forged to shape, should be cooled and ground before hardening, and a clearance angle of about 30 deg. for flat and cape chisels has proved to be satisfactory.

Heating chisels properly for hardening in an ordinary

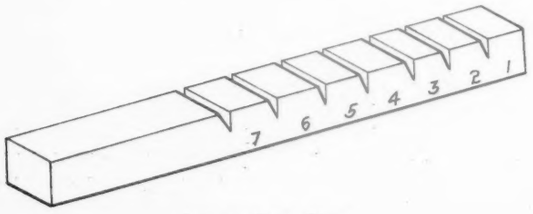


Fig. 3—Test Piece

furnace is not as simple as commonly supposed. Care should be taken to heat the heavier part of the chisel first, allowing the thin edge to come to the required temperature last. This prevents "soaking" the very part of the chisel that should be the strongest, and soaking at a low heat is nearly as bad as overheating. The quenching should be done in brine and at the lowest heat at which the steel will retain its full hardness, which is generally about 1350 deg. F.

To find out whether the heat is too high or too low, test the tool with a file or chip off a little piece from a chisel occasionally and compare the fracture with that of the test piece showing the best grain. Whether the chisels are to be tempered in oil or run down to color, quench far back from the edge, at least 2½ in., and stir up and down while cooling to avoid making a sharp line of demarcation between the hot and cold portions, thus forming a water crack like that shown in Fig. 4. It is a very common and grave fault

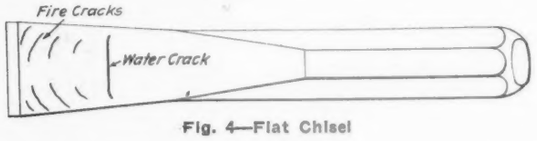


Fig. 4—Flat Chisel

to quench a chisel only about ⅜ or ½ in. from the edge, because at that point the section is thin enough to produce a water crack readily, and these rarely appear on the surface until the tool is in use.

By far the best mode of tempering is in the oil bath, and for ordinary hand chisels the writer's experience has been that the best results are obtained at temperatures of about 570 deg. F. This leaves the chisel hard enough for ordinary chipping and reduces the liability of a broken tool when splitting a nut or wedging off a patch. Chisels used exclusively for chipping and air hammer tools should be made considerably harder.

The redressing of chisels requires more care than when new chisels are being made. A piece of hardened steel is in some respects like a piece of glass. When heated at a rate that is faster than that at which the heat can be absorbed, the hotter parts expand beyond the elastic limit and break away from the cooler parts. Of course the elastic limit of steel is much higher than that of glass, but the number of chisels returned full of fire cracks is abundant proof that it is frequently exceeded. Fig. 4 is a good illustration of a chisel having both fire and water cracks.

A chisel may be shaped right and hardened right and like any other tool may be spoiled in the grinding, so it is important not to overheat the cutting edge while grinding. It is also true that each time a tool is redressed it becomes more

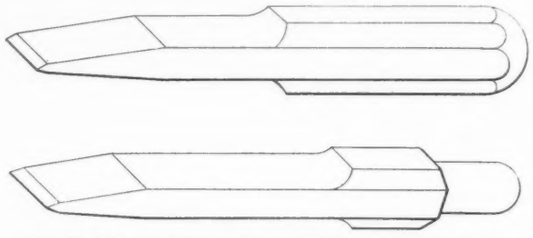


Fig. 5—Chisels Drawn From Short and Scrap Pieces

difficult to make it stand up, because something has been taken out of the steel which can never be replaced.

For general purposes chisels should be ground to an angle of about 30 deg., but this may not be the best angle for a special case. If a machinist grinds his lathe tools blunt to cut cast iron and thin to cut soft steel, why not apply the same rule to cold chisels? Some men seem to think that if a chisel is tempered right it can be neither bent nor broken, but these are generally the kind that will try to take off a ½-in. chip of Thermite metal with a chisel ⅛ in. thick at the point. A common method of breaking the corners of a chisel is to drive it under a rivet head, and this may be

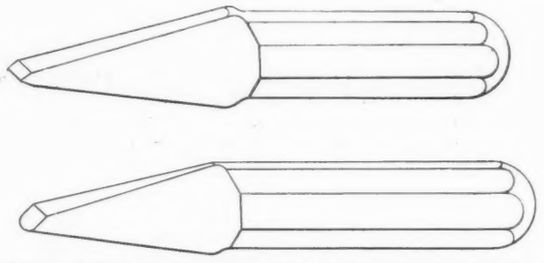


Fig. 6—Cape And Round Nose Chisels Showing Clearance

prevented by starting the cut about 1/16 in. above the bottom of the head. Connecting two cuts not in the same line, or cutting to a curved line with a wide chisel is also bad practice, and of course there are many other ways of abusing chisels. Yet mechanics will continue to break good tools time and again in the same way without ever looking for the cause.

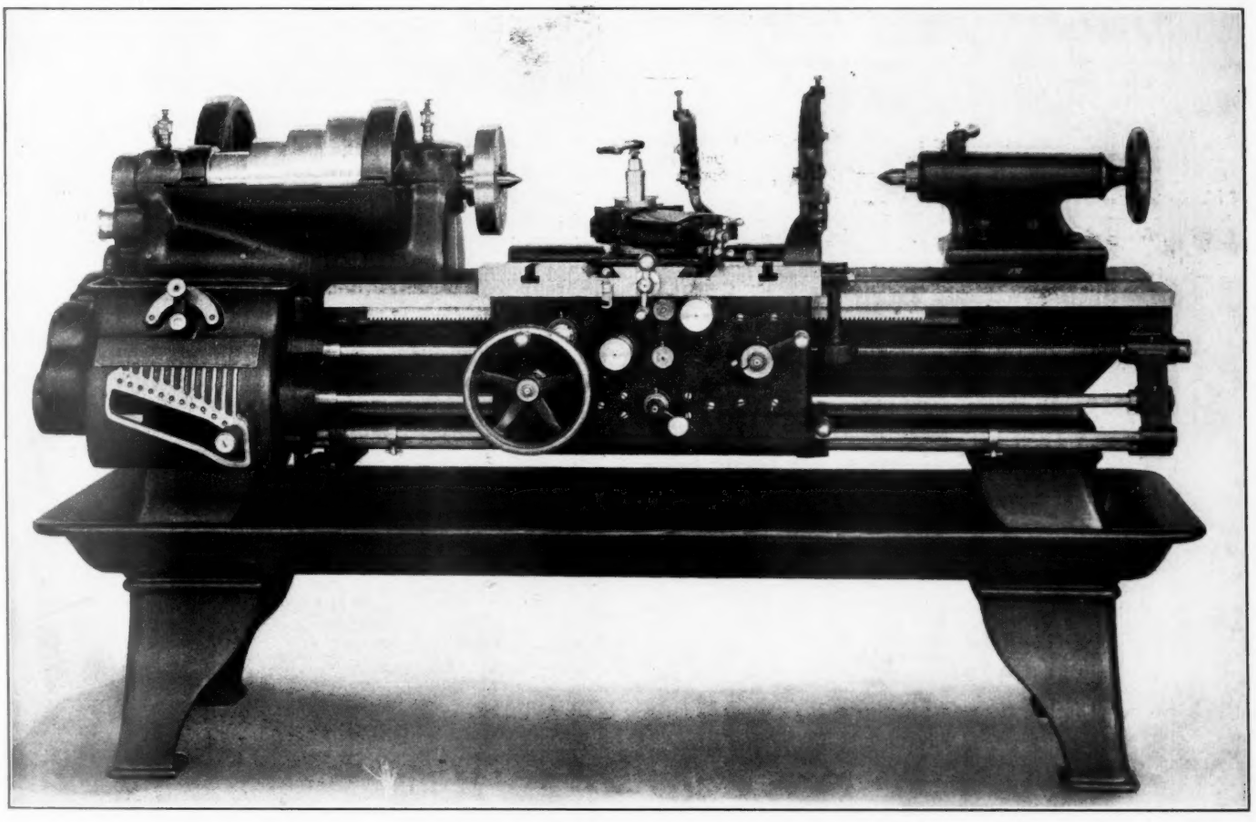
No one ever seems to take any account of these faults, because chisels are so cheap and easily obtainable, but if everything were taken into consideration—the cost of the steel, the time lost by the mechanic and helper and the time of the toolmaker and helper—it would be found to be expensive carelessness.

SAFETY AND SANITATION WORK SHOWS RESULTS.—The Industrial Commission of Wisconsin reported on December 22 that during the last half of 1917, industrial accidents in Wisconsin workshops and factories showed a reduction of 14 per cent from the corresponding period of 1916. This is due to the special effort made by the commission to interest foremen and superintendents in safety and sanitation work.

NEW DEVICES

SUNDSTRAND TOOL ROOM LATHE

The new 16-in. quick change lathe known as the Sundstrand and illustrated below was recently developed by the Rockford Tool Company, Rockford, Ill., and extra heavy construction combined with maximum convenience of operation make it especially adaptable to railway tool room service. The lathe is built to stand heavy cuts and another feature is the use of both speeds of the countershaft to drive the spindle in the same direction, which doubles the number of available speeds and prolongs the life of the belt.



A Quick Change Lathe for Tool Room Work

The bed of the late is heavy and strongly braced. The headstock is ribbed and securely clamped to the bed to prevent chatter. There is a single back gear and a four step cone pulley is regularly furnished. The bearings for the spindle are phosphor bronze of generous proportions and are provided with sight feed self-oilers. The end thrust on the rear bearings is taken by a large ball thrust bearing. The tail stock is of the cut away type and the tail spindle is graduated for convenience in drilling. The lead screw is not splined and being used for thread cutting only, should retain its accuracy a long time. Any number of threads from 1½ to 80 per inch, including the 11½-in. standard pipe thread, can be cut.

The apron is of double construction, all gears and studs being supported at both ends. It is securely fastened to the carriage and is designed to withstand heavy stresses. A positive lock is provided in the apron to make it impossible for the lead screw and the feed rod to be engaged at the same time.

The reverse mechanism is mounted in large bearings in the headstock and an independent feed rod is provided which may be reversed by a lever shown on the right side of the apron.

A well designed, quick change gear box is mounted on the front of the bed and by the use of two handles it is possible to quickly obtain any one of 36 different speeds.

Considerable attention has been given to the design of a

suitable taper attachment and all carriages are drilled to take the attachment in case it is needed later on.

There is also a special relieving attachment for accurately backing off or relieving the teeth of hobs, cutters, taps, etc. It is driven from the back gear through a quadrant firmly clamped on the lathe bed in the rear of the headstock.

The regular equipment furnished with this lathe includes a special gear for cutting the 11½-in. thread, large and small face plates, a double friction countershaft, oil pans and suitable wrenches. Following is a list of important dimensions of the lathe:

Swing over bed	16¾ in.
Swing over carriage	9⅞ in.
Distance between centers	32 in.
Length of bed	6 ft.
Width of bed	15 in.
Width of belt	2¾ in.
Tool post takes ⅝ in. by 1¼ in. tool.	
Feeds	from 6 to 320 per in.
Net weight, approximately	2,800 lb.

PAINT SPRAYING SYSTEM

Many methods of applying paint in the form of a spray by means of compressed air have been suggested, and one that is used successfully is the Aeron system developed by the De Vilbiss Manufacturing Company, Toledo, Ohio. This system is used extensively in the industrial field and has wide possibilities in the railroad field. It is now used

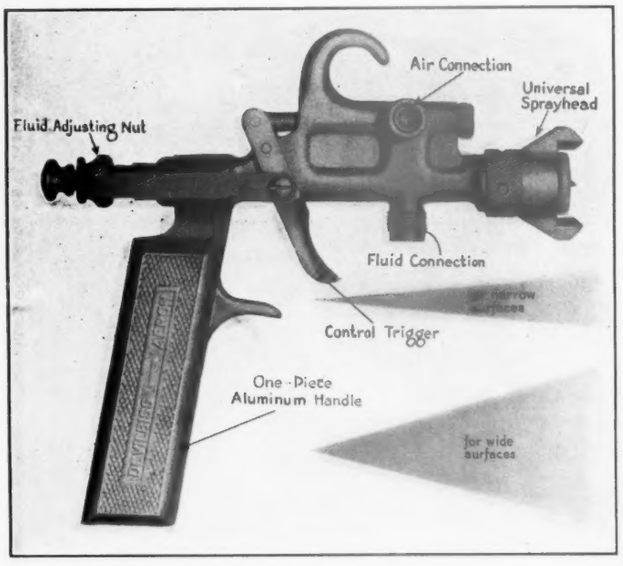


Fig. 1—Paint Spraying Nozzle.

by some roads for painting equipment and buildings. It is a great time and labor saver and as such should be seriously considered by railway men. The Aeron system is so designed that it may be operated without materially wasting paint.

The nozzle is in the form of a pistol with the control trigger always under the operator's finger and within four inches of the spray head. This allows the paint to be applied exactly where it is needed and reduces to a minimum any loss in paint. An adjustable nozzle is provided which governs the width of the spray. All kinds of varnishes, enamels, lacquers and oil paints may be used with the Aeron system, which is easy to install and operate and does a uniformly high grade of work. It may be used to good advantage in the painting of car bodies, trucks, stencils, locomotives, car interiors and exteriors. Among the advantages of paint spraying as compared with the old hand brush method, may be mentioned the following: Much greater speed, less paint used, less wasted, rough and inaccessible surfaces covered more uniformly and the possibility of cleaner and better working conditions. A portable painting equipment has been developed which consists of a suitable air compressor,

Fig. 2—A Difficult Painting Job Made Easy.

belt driven from a small gasolene engine and mounted on a portable truck. A paint tank and regulating head, together with an air receiver are also mounted on the truck. Suitable hose and connections are provided for use with the

Fig. 3—Paint Sprayer Used for Stenciling.

nozzle. Where compressed air is available the air compressor and gas engine would be unnecessary.

The really vital part of the Aeron equipment is the nozzle, which is shown in Fig. 1 with the connections and attachments plainly indicated. The flow of air and paint is under the instantaneous control of the operator by means of the

trigger and the universal spray head produces a flat spray which may be adjusted horizontally or vertically, or for wide or narrow surfaces. Wide surfaces may be covered with rapidity and uniformity.

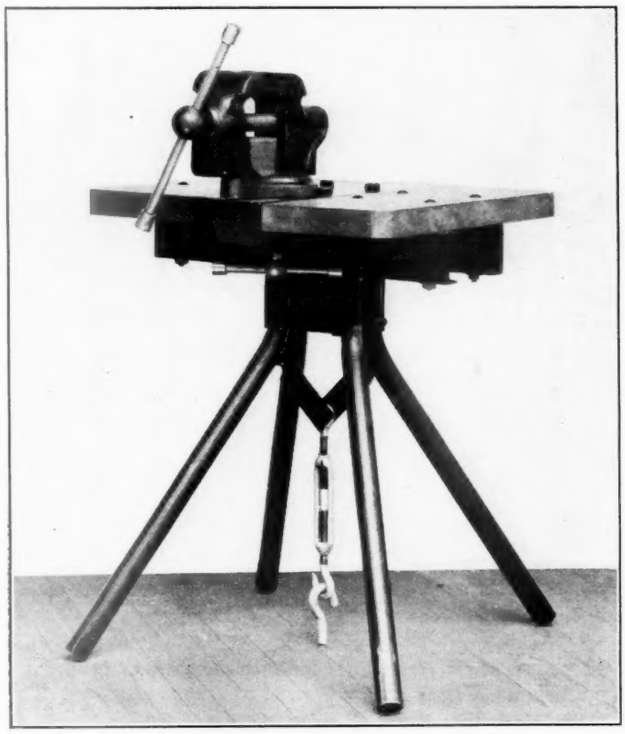
In operation, the paint tank regulating head inlet is connected by ½-in. air hose to the compressor air system. One or more nozzles are then connected by ⅜-in. air hose and ½-in. fluid hose to the regulating head outlet. The paint is put into the tank through a filler plug hole. With the regulator shown in Fig. 2 and the fluid adjusting nut on the nozzle, the air pressure is controlled to meet varying conditions of size of nozzle, viscosity of paint, height of nozzle above tank, etc. Special extension nozzles are provided for use in unusually difficult places.

Painting car trucks is a slow, troublesome job by the old paint brush method and Fig. 2 shows how the work may be done by use of the Aeron system. Fig. 3 shows it used in stenciling a car body. In fact, the system is very flexible and may be easily adapted to the varying conditions that have to be met in railway practice.

A PORTABLE VISE AND BENCH

Strength and maximum convenience in handling are the points especially emphasized in a new portable vise which is manufactured by the Henderson Electric Company, Ampere, N. J.

The vise is made in two patterns, the larger of which is shown in the illustration and weighs 225 lb. The table is 30 in. by 36 in. by 2 in. and the legs are made of 2-in.



A Convenient Portable Vise

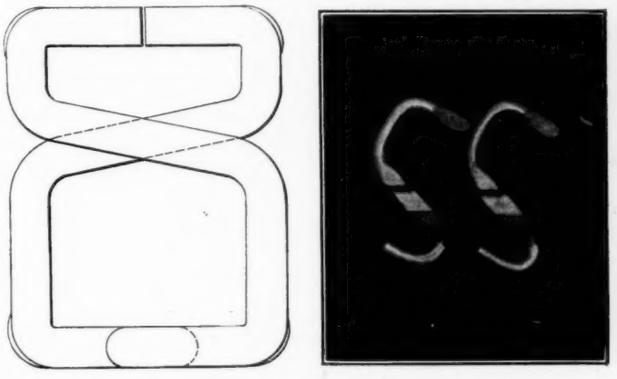
pipe. To insure solidity, the table is fastened to the floor by means of a turnbuckle and lag screw which is clearly shown in the illustration.

A portable vise of this kind should be of value in shops and roundhouses where it could readily be placed near the location of the work and thus result in the saving of many steps.

A. & Z. BRAKE BEAM HANGER

A new brake beam hanger recently devised by L. E. Atwell, roundhouse foreman, and C. A. Zweibel, supervisor of car repairs, of the Atlantic Coast Line, is of especial interest. Simplicity, ease in application, durability and cheapness are among the advantages claimed for the A. & Z. hanger, as it is known, and it is being used successfully on the tenders of several Atlantic Coast Line locomotives. The hanger is composed of two forged wrought iron pieces which are interchangeable.

In order to apply the hanger, which may be done easily from the outside, it is simply necessary to remove the brake key and shoe, and lower the brake beam. The two sections of the hanger are then suspended from the hanger bracket and allowed to come together at the center which automatically locks them in place. To complete the job, it is only necessary to raise the brake beam, hook the bottom of



A. & Z. Brake Beam Hanger

the hanger into the slotted hole in the brake head and apply the brake shoe and key. The corners are reinforced and stiffened by extra ribs and the lap joint in the bottom of the hanger increases its stiffness. Obviously, there are no nuts or cotters to work loose and the hanger should prove durable as well as cheap.

CARBOCOAL—A NEW FUEL

A new commercial process for converting bituminous coal into a fuel which is smokeless and has the characteristics of anthracite coal, has been invented and perfected by C. H. Smith, who has been working on this new process for some time in conjunction with Blair & Company, of New York. The bituminous coal is taken in its raw state and subjected to a distillation process at relatively low temperatures, which distills off vapors and permanent gases, leaving what is called Carbocoal to be made into briquettes. An important feature is that valuable by-products are obtained from the gases, the revenue from the sale of which largely compensates for the cost of the process.

The residue from the distillation is pressed into hard and durable briquettes. These briquettes are practically pure carbon, having only one to four per cent volatile matter. They provide an intense fire and are adaptable for use on locomotives where high steaming rates are required. The adaptability of this fuel for locomotive use has been determined by actual locomotive tests, at which high rates of combustion were obtained with practically no smoke. It has been found particularly suitable for use where limited grate area is obtained and restricted boiler capacity requires an efficient fuel. It is easily handled; the briquettes do not readily disintegrate.

The accompanying table shows the products obtained from

the raw bituminous coal by the distillation process. The coal tar products are recovered in their primary stage, there being available some 20 gallons of tar oils for the market as compared with four or five gallons from the same grades of coal in the ordinary carbonization process. Many of the

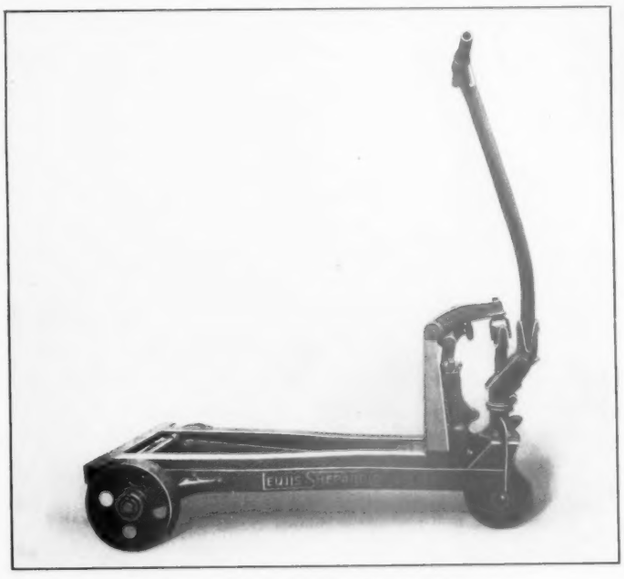
Raw Bituminous Coal—2,000 lb.
- Carbocoal Briquettes—1,440 lb.
- Gases and Vapors—560 lb.
  - Vapors—360 lb.
    - Tar Oils—Benzol, Toluol, Naphthas, Motor Spirit, Creosote, Oils, Tar Acids, Lubricating and Fuel Oils, Anthracene, Pitch and other tar oil products.
    - Ammonical Liquor—Ammonia (Concentrated), Sulphate of Ammonia, Cyanogen, Pyridene bases and other nitrogen compounds.
  - Permanent Gases—200 lb.
    - These are used to provide heat for the distillation process, or may be used for commercial purposes.

by-products which are obtained by this process are in great demand for use in the manufacture of explosives.

Such a fuel will find a field on railroads, for domestic use, in stationary and marine plants where smokeless operation is desired, and for kilns and gas producers. This process is being handled by the International Coal Products Corporation, of which Mr. Smith, the inventor of the process, is president. An experimental plant has been in operation at Irvington, N. J., and plans are now under way for the construction of new plants.

A HIGH LIFT INDUSTRIAL TRUCK

In the efficient handling of freight and stock from platform to storeroom, different forms of industrial lift trucks are becoming more and more important factors and their use has spread to railroad repair shops and freight houses. One of these trucks, recently developed by the Lewis-



Model 10 W S B Jacklift Master Truck

Shepard Company, Boston, Mass., intended especially for railroad work, is shown in the illustration.

With a capacity of 3,500 lb. and large rear wheels to insure easy rolling, it combines the added advantage of a universal joint which permits the load to be raised with the handle in any position. In this way it is possible to use the truck in freight cars and other cramped quarters hitherto inaccessible, and a total lift of 2½ in. allows the wooden platforms to be pulled over inclines and other irregularities in the floor.

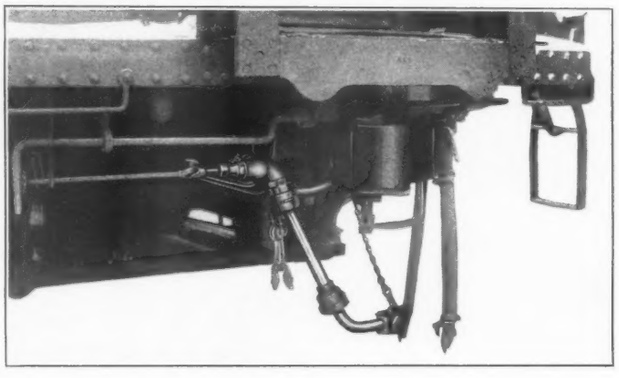
The load is elevated by a combination of leverages requiring from four to six short strokes of the handle and a ratio of 40 to 1 gives a powerful purchase. In lowering, a release check permits the load to descend slowly to the floor and eliminates the possibility of spills.

At one freight depot where this truck is in use, all incoming freight is unloaded directly onto small platforms made for the purpose. Platform and freight are then moved by the aid of a truck to their destination without rehandling.

ALL METAL STEAM HEAT CONNECTION FOR CARS

With a view to providing a connection for the steam lines for passenger cars that would reduce the trouble and expense incident to the use of rubber hose, the Barco Manufacturing Company, Chicago, has developed a connection in which no rubber is used. This device has recently been placed upon the market after it had been in use for four years.

The Barco car steam heat connection is made up of two Barco joints of a special type and two sections of extra heavy steel pipe. Any standard steam-heat coupler head can be used on it. A locking clamp secures the upper flexible joint to the train line end valve, making it impossible for the connection to fall to the track. If desired lagging can be applied to the connection, but in most of the installations this has



Passenger Car Equipped with Barco Steam Heat Connection

not been done. It is desirable to have a flexible bracket at the end of the train line of a type similar to that shown in the illustration.

No special tools are required to apply or remove these connectors. They will couple to cars equipped with rubber hose as well as to those having the Barco connection. The joints are more flexible than rubber hose, which makes them easier to couple. They will stand the full boiler pressure of the locomotive without leaking or bursting. The steel pipe gives a larger opening for the passage of the steam than rubber hose and eliminates the trouble due to the rubber lining becoming loose and stopping the pipe or catching in the valves. The all-metal connections remain serviceable for a long time and do away with frequent renewals.

Exportation of Scrap Iron or Steel.—The War Trade Board calls attention to the fact that the exportation of scrap iron or steel requires an export license, and that any shipper who exports under any different classification (such as second-hand rails, car wheels, etc.) any articles manufactured of iron or steel which are exported for the purpose of being scrapped at destination is guilty of false declaration and is subject to such penalties therefor as the law provides.

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 8,100 copies were printed; that of these 8,100 copies 6,955 were mailed to regular paid subscribers, 115 were provided for counter and news companies' sales, 330 were mailed to advertisers, 162 were mailed to exchanges and correspondents, and 538 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 24,900, an average of 8,300 copies a month.

The RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.).

The shops of the Pennsylvania at Blairsville, Pa., on the Conemaugh division—a machine shop, a blacksmith shop and a boiler house—were destroyed by fire on February 5. Estimated loss, $15,000. The fire occurred at 3 a. m. when the temperature was 10 deg. below zero.

The executive committee of the Master Car Builders' Association has issued Circular No. 26 announcing that the Interstate Commerce Commission has extended the date effective for the application of safety appliances to cars to September 1, 1919. To conform thereto, paragraph (m) of Rule 3 should read: "After September 1, 1919, no car will be accepted in interchange unless properly equipped with United States safety appliances or United States safety appliances, standard."

The shopmen of the Grand Trunk are to have a general increase in pay, aggregating, it is said, more than $500,000, on all of the company's lines. The advance is in accordance with the decision of a board of conciliation which has recently made a unanimous report. The men affected are the machinists, the boilermakers and the blacksmiths, said to be about 1,300 men in all. The report also provides that grievance committees shall be established in the shops; the working day is to be nine hours and the rate of pay is to be advanced 50 per cent for overtime and for work done on holidays. The agreement runs one year from March 1.

A pledge to save fuel oil is called for by Albert E. Swabacher, United States fuel administrator for California, who has sent a letter to all locomotive enginemen in that state. The Southern Pacific is the greatest consumer of fuel oil in that state and the co-operation of its employees is expected to mean in the aggregate a great saving for other industries. Mr. Swabacher's letter says that the storage supply of fuel oil in California is decreasing at the alarming rate of 1,100,000 barrels a month. The abnormal demands of the last three years have decreased the available storage supply by one-half. The pledge cards, sent to the firemen of all California roads, are being signed and returned to the fuel administrator.

Conference on Conservation of Railway Fuel

A conference recently was held in Chicago between Major E. C. Schmidt, representing the Fuel Administration, and a number of representatives of the railways regarding methods which should be adopted to promote greater conservation of fuel by the railways. Major Schmidt, who was formerly professor of railway mechanical engineering in the University of Illinois, has been assigned by the War Department to the Fuel Administration, and the conference was called by him. Almost a year ago the International Railway Fuel Association appointed a committee which tendered its services to the government for the purpose of bringing about co-operation regarding the use of fuel by railways. The members of this committee participated in the conference with Major Schmidt. They include Eugene McAuliffe, chairman, formerly general coal agent of the Frisco system, who is now in the coal business; W. L. Robinson, Baltimore & Ohio; E. W. Pratt, Chicago & North Western; L. R. Pyle, Soo Line, and D. C. Buell, Railway Educational Bureau. Others who participated in the conference were M. K. Barnum, Baltimore & Ohio; John Crawford and A. W. Wilson, Burlington, and Charles Hall, Indiana Coal Operators' Association. It is an unsettled question whether the matter of fuel conservation on the railways will be handled by the Fuel Administration or under the Director General of Railroads.

Following the Chicago conference, the Executive Committee of the International Railway Fuel Association telegraphed the Fuel Administrator, tendering the services of the association, its members and its executive committee, to the conservation division of the Fuel Administration.

Second Tobacco Shipment to Railway Regiments

On February 23 the committee in charge of the Railway Regiments' Tobacco Fund forwarded its second shipment to the railroad regiments in France. The shipment consisted of 10 cases of 12 packages each. Each package contained 240 bags of Bull Durham smoking tobacco and 80 bags of Tuxedo pipe tobacco.

The tobacco is bought at wholesale prices and is not subject to revenue charges because it is consigned to government forces. It is delivered in bond to the Quartermaster's Department of the Army in this country, which takes care of its transportation without expense to the donators. The members of the committee in charge of the Tobacco Fund, of which F. A. Poor, president of the P. & M. Company, is chairman, themselves pay all of the office expenditures.

A letter received by Mr. Poor from Fred A. Preston, secretary and treasurer of the P. & M. Company, and now a

captain in the regular army in France, indicates to what an extent "smokes" are appreciated by the boys in France:

"The cigarettes arrived and I am the most grateful person in the world. Today for the first time in weeks I am having a real smoke. As I have told you before, I simply can't tell you how much smoking means to every one of us. There is something about the climate or the work that makes smoking absolutely indispensable. Whereas I formerly consumed about five a day, I now smoke 25, sometimes more, and because good cigarettes are not obtainable we smoke any d—— thing."

Although a large number of supply companies have responded generously to the appeal for subscriptions, there is still a need for additional funds and contributions from other companies are solicited.

One contribution to the Railway Regiments' Tobacco Fund was received during the past month from the Empire Steel & Iron Company of Catasauqua, Pa., for $20.

Backing Up the Boys at the Front

The following letter, which is self-explanatory, has been sent out to each of the more than seventy employees of the Seaboard Air Line shops and offices at Portsmouth, Va., who have joined the colors:

We, your fellow workers who are left behind, thinking you would like to hear from others than "Homefolks" back home, wishing to encourage you and at the same time to impress the fact that we are back of you to a man, have decided on what we think to be the most all around effective method. The Seaboard Air Line shop employees have gone together, as one man, in a society called the "Portsmouth Patriotic Society of Seaboard Shops." . . .

The objects of this society are: To keep in touch with each of you who have enlisted in the nation's service, sending you periodically each month while the war lasts a shop letter telling you all the happenings of interest in Portsmouth, and following this, a small token of remembrance, such as tobacco, cigarettes, etc.; to keep in touch with your relatives back home, so that if ever at any time they are in need of any kind of help there will always be a willing helping hand to respond.

Now, this is our part—you will also have some duties to perform in connection with this society: Keep us posted as to your whereabouts as near as you possibly can. . . . as sometimes there may be some real good news to impart, and you will get it much quicker if we know exactly where to address you.

Your second duty is that, if there is ever anything we can do for you here, not to hesitate to call on us. Maybe there is something we can do in the way of keeping in touch with your relatives, and if so, the society, as one stanch friend, will consider it a privilege to help you. . . .

Attached to this letter you will find a membership card, and you will note that your name is entered thereon as honorary member. Each one of us appreciates what you are doing, and considers this a privilege.

We have placed an honor board under "Old Glory" near entrance to the shops, and the name of each of you who have responded so readily to the call of our country is printed on it. We add new ones now and then, and the board is filling very quickly. . . .

In closing we want to remind you to be on the lookout for a package which will follow the letter you receive from us each month. Hoping you will get encouragement and pleasure from being an honorary member of the Portsmouth Patriotic Society of Seaboard Shops, and wishing you lots of luck, we remain. Your friends back home,

PORTSMOUTH PATRIOTIC SOCIETY.

MEETINGS AND CONVENTIONS

American Society for Testing Materials.—The twenty-first annual meeting of the American Society for Testing Materials will be held at the Hotel Traymore, Atlantic City, N. J., on June 25 to 28, 1918. Atlantic City was selected as the place for this meeting on the basis of the information received a year ago in reply to a detailed inquiry addressed to the membership which showed a decided preference for this city over others suggested. The annual meetings of this society have been held at Atlantic City for the past 16 years, with the single exception of that in 1903.

New York Railroad Club.—The next meeting, on March 15, 1918, will be the annual Electrical Night. The following is the program for the occasion, the subject being "Recent Electric Locomotives."

The New York, New Haven & Hartford new 180-ton passenger locomotive, which will be presented by E. R. Hill.

The Chicago, Milwaukee & St. Paul new gearless, bi-polar passenger locomotive under construction by the General Electric Company, which will be described by A. H. Armstrong, illustrated by lantern slides from photographs of the general drawings.

The Chicago, Milwaukee & St. Paul new quill geared locomotive under construction by the Westinghouse Electric & Manufacturing Company, which will be described by F. H. Shepard of the Westinghouse Company and illustrated by lantern slides.

The New York Central latest electric passenger locomotive which will be briefly described by Mr. Katte and illustrated with lantern slides.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention May 7 to 10, 1918, Cleveland Ohio.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Bldg., Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Annual meeting June 25-28, 1918, Hotel Traymore, Atlantic City, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Bldg., Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Mar. 12, 1918	Locomotive Repairs	E. R. Battley	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Mar. 8, 1918	Terminal Handling of Locomotives; Annual Report of Committee on Interchange Rules	Frank C. Pickard	Harry D. Vought.	95 Liberty St., New York.
Cincinnati	May 12, 1918			H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Mar. 12, 1918	Annual Meeting, Election of Officers and Reports, and Talk on War Conditions		W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Mar. 15, 1918	Annual Electrical Night		Harry D. Vought.	95 Liberty St., New York.
Pittsburgh	Mar. 22, 1918	Revision of M. C. B. Rules of Interchange.	R. L. Kline	M. J. Hepburn	102 Penn. Station, Pittsburgh, Pa.
St. Louis	Mar. 8, 1918	The St. Louis Terminals	H. J. Pfeifer	B. W. Frauenthal.	Union Station, St. Louis, Mo.
Western	Mar. 18, 1918	Ry. Problems Investigated at Purdue Univ.	Prof. G. A. Young	Joseph W. Taylor.	1112 Karpen Bldg., Chicago.

PERSONAL MENTION

GENERAL

H. T. BENTLEY, superintendent of motive power and machinery of the Chicago & North Western at Chicago, has been called to Washington, D. C., for an indefinite period to join the staff of the director-general of railroads.

F. F. GAINES, formerly superintendent motive power of the Central of Georgia, has been made a member of the staff of Regional Railroad Director C. H. Markham, at Atlanta, Georgia.

N. C. KIEFFER has been appointed fuel agent of the Southern Railway, lines west, with office at Cincinnati, Ohio, succeeding R. D. Quickel, entered military service.

T. D. SEDWICK, acting engineer of tests of the Chicago, Rock Island & Pacific, with headquarters at Chicago, Ill., was appointed engineer of tests, with the same headquarters.

F. O. WALSH, superintendent of motive power of the Georgia Railroad, has also been appointed superintendent of motive power and equipment of the Atlanta & West Point and the Western Railway of Alabama, at Montgomery, Ala.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

FRANK AITKEN, master mechanic of the Pere Marquette at Wyoming (Grand Rapids), Mich., has been appointed master mechanic of the Chicago Great Western at Des Moines, Iowa, to succeed W. H. Erskine.

RAY AUSTIN, heretofore a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been appointed traveling engineer of the Illinois division.

H. H. CARRICK, assistant master mechanic of the Southern Pacific at San Francisco, Cal., has been appointed master mechanic of the Stockton division, with headquarters at Stockton, Cal., succeeding F. P. McDonald, transferred.

W. C. DAVIS has been appointed road foreman of engines of the Shasta division of the Southern Pacific, with headquarters at Dunsmuir, Cal., succeeding R. W. CUVELLIER, assigned to other duties.

W. H. DEMPSEY, formerly a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been made traveling engineer of the Chicago and Milwaukee division.

HENRY DERSCH, an engineman of the Chicago, Milwaukee & St. Paul, has been promoted to the position of traveling engineer of the Prairie du Chien and Mineral Point divisions.

W. H. ERSKINE, master mechanic of the Chicago Great Western, at Des Moines, Iowa, has been appointed master mechanic of the Virginian Railway.

J. F. GILDEA, division master mechanic of the Canadian Pacific, with office at Montreal, Que., has been appointed master mechanic of the Pennsylvania division of the Delaware & Hudson, with headquarters at Carbondale, Pa., succeeding J. J. Reid, resigned.

RALPH E. GRAVES, a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been made traveling engineer of the Superior division.

F. B. HIGBEE, a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been appointed traveling engineer of the Southern Minnesota division.

G. P. HODGES, general car and locomotive foreman of the Chicago, Milwaukee & St. Paul, with headquarters at Mason City, Iowa, has been appointed division master mechanic of the Iowa and Dakota division, at the same point.

J. M. KERWIN, master mechanic of the Chicago, Rock Island & Pacific, with headquarters at Estherville, Iowa, has been transferred to newly opened headquarters at Silvis, Ill.

EDWARD M. LAKE has been appointed master mechanic of the Meridian & Memphis, with office at Meridian, Miss. He was born at Mobile, Ala., in 1870, and his first railroad experience was as a machinist apprentice with the Louisville & Nashville. He was afterward employed by the New Orleans & North Eastern as a machinist, and was subsequently appointed roundhouse foreman. He later went with the Gulf & Ship Island as master mechanic, and was latterly foreman of the New Orleans, Mobile & Chicago at Laurel, Miss.

B. A. LEMBKE, formerly a locomotive engineman, has been promoted to traveling engineer of the Wisconsin Valley division of the Chicago, Milwaukee & St. Paul.

GEORGE H. LUSK, formerly a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been appointed traveling engineer of the Iowa West and Des Moines division.

JOHN P. LUTZE, a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been appointed traveling engineer of the Iowa East and Middle division.

A. M. MARTINSON, formerly a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been appointed traveling engineer of the Racine & Southwestern, and Rochelle & Southern line.

C. H. MCCRUM has been appointed traveling engineman of the Kansas City division of the Chicago, Milwaukee & St. Paul. He was formerly a locomotive engineman.

H. C. MCCULLOUGH has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla.

R. J. MCQUADE, general foreman of the locomotive department of the Chicago, Rock Island & Pacific at Chicago, has been appointed master mechanic to succeed J. M. Kerwin, with headquarters at Estherville, Iowa.

F. P. MILLER, general car and locomotive foreman of the Chicago, Milwaukee & St. Paul, at Marion, Iowa, has been appointed division master mechanic of the Iowa division, with the same headquarters.

W. P. MURPHY has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla.

GEORGE E. PASSAGE, a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been promoted to traveling engineer of the Chicago terminals.

J. H. PHILLIPS, traveling engineer of the Chicago, Milwaukee & St. Paul, has been appointed division master mechanic of the Northern division, at Horicon, Wis.

CHARLES RAITT, general foreman of the car department of the Atchison, Topeka & Santa Fe, at Richmond, Cal., has been appointed master mechanic of the Arizona division, at Needles, Cal., succeeding L. A. Mattimore, deceased.

H. S. ROWLAND, formerly a locomotive engineman of the Chicago, Milwaukee & St. Paul, has been appointed traveling engineer of the Sioux City and Dakota division.

J. T. SLAVIN has been appointed assistant master mechanic of the Coast division of the Southern Pacific, with headquarters at San Francisco, Cal., succeeding H. H. Carrick.

W. B. STEEVES, locomotive foreman of the Canadian Northern, with headquarters at Saskatoon, Sask., has been promoted to assistant master mechanic of the western district, with headquarters at Edmonton, Alta.

R. R. Stockwell, formerly a locomotive engineman, has been appointed traveling engineer of the Dubuque division of the Chicago, Milwaukee & St. Paul.

E. M. Sweetman, master mechanic of the Southern Railway, with office at Spencer, N. C., has been transferred to the Coster shop, Knoxville, Tenn., as master mechanic, succeeding N. N. Boyden, resigned to go into other business.

J. C. Woods has been appointed acting master mechanic of the Quincy, Omaha & Kansas City and the Iowa & St. Louis, with office at Milan, Mo., succeeding C. H. Montague, master mechanic, who has resigned.

CAR DEPARTMENT

E. B. Colton, assistant car foreman of the Chicago & Eastern Illinois at Danville, Ill., has been appointed car foreman, succeeding C. E. Bumpus, promoted.

John L. Conerly, whose appointment as master car builder of the Missouri, Kansas & Texas, with headquarters at Denison, Texas, was announced in the January issue, was born in Pike county, Miss., on November 22, 1869. He entered the service of the Illinois Central in December, 1890, as car repairer at McComb, Miss., and was later promoted to inspector. On December 31, 1900, he was promoted to car foreman and transferred to Jackson, Miss., where he remained until June, 1903, when he was transferred to New Orleans, La. He remained at New Orleans until June, 1910, when he was promoted to general car foreman and transferred to Memphis, Tenn. He left the Illinois Central in February, 1914, to take a similar position with the Missouri, Kansas & Texas, at Denison, Texas, and in September, 1914, he was promoted to general car inspector. He was with the Ft. Worth & Denver City and the Midland Valley from September, 1915, to February 15, 1917. He returned to the Missouri, Kansas & Texas as general car inspector on February 15, 1917, and from this position was promoted to master car builder, effective January 1, 1918, succeeding H. J. Tierney, resigned.

E. H. Mattingly, formerly car foreman of the Baltimore & Ohio at South Chicago, Ill., has been appointed joint general car foreman of the Chicago district of the Baltimore & Ohio and the Baltimore & Ohio Chicago Terminal Railroad.

F. C. Rudloff has been appointed foreman of the car department of the Missouri, Kansas & Texas at Denison, Texas, succeeding W. H. Macon, transferred.

A. G. Saunders has been appointed master car repairer of the Tucson division of the Southern Pacific, with headquarters at Tucson, Ariz., succeeding E. M. Dickerman, resigned.

O. E. Shaw, general car foreman of the Chicago & Eastern Illinois at Danville, Ill., has resigned to take a position as master car builder of the Wilson Car Lines at Chicago.

J. M. Wood has been appointed foreman of freight car repairs of the Georgia Southern & Florida at Macon, Ga., succeeding C. F. Roberts, resigned.

SHOP AND ENGINEHOUSE

H. W. Burkheimer, formerly assistant foreman of the roundhouse of the Southern Railway at Knoxville, Tenn., has been appointed night foreman of the roundhouse.

C. F. Karns, a boilermaker in the Coster shops of the Southern Railway, at Knoxville, Tenn., has been appointed assistant boilermaker foreman.

J. A. Murrian has been made assistant foreman of the roundhouse of the Southern Railway at Knoxville, Tenn.

V. N. Potts has been appointed general foreman of the locomotive department of the Chicago, Rock Island & Pacific, with headquarters at Liberal, Kan.

J. P. Spears, formerly night roundhouse foreman of the Southern Railway at Knoxville, Tenn., has been appointed general roundhouse foreman.

PURCHASING AND STOREKEEPING

W. E. Allen has been appointed purchasing agent of the Gulf, Florida & Alabama, with office at Pensacola, Fla.

J. A. Brackett, division storekeeper of the Atchison, Topeka & Santa Fe at Calwa, Cal., has been transferred to Bakersfield, Cal., succeeding W. H. Bunch, who has entered the National Army.

J. L. Diessl, division storekeeper of the Atchison, Topeka & Santa Fe, at Riverbank, Cal., has been transferred to Calwa, Cal., succeeding J. A. Brackett, transferred.

James E. Garnett, division storekeeper of the Southern Railway at Memphis, Tenn., has been appointed division storekeeper, with office at Sheffield, Ala., succeeding H. H. Delony, resigned to accept service elsewhere.

J. W. Riddings has been appointed storekeeper of the Atchison, Topeka & Santa Fe at Richmond, Cal., succeeding H. I. Heath, who has entered the National Army.

M. Velasco has been appointed local purchasing agent of the Constitutionalist Railways of Mexico, with office at New York, succeeding F. E. Carrero, resigned.

COMMISSION APPOINTMENT

Hiram W. Belnap has been appointed manager of the Safety Section of the Division of Transportation of the United States Railroad Administration. Mr. Belnap has been with the Interstate Commerce Commission for 15 years, for the past seven years as chief of the Bureau of Safety, and for the preceding eight years as inspector of safety appliances. Previous to that he had had 14 years' experience in various capacities in train operation. It is announced that, as manager of the Safety Section, "he will deal directly with each railroad, supervising such organizations for safety as are already available, bringing about such uniformity in practice as is deemed necessary, and suggesting such additional organizations and such modifications of practice as are desired. . . . The director general feels strongly that there should be no abatement whatever in the safety work on the railroads, but that there should be centralized supervision, not only to insure proper practices, but also in order that each railroad may promptly secure the advantage of experience which other roads have had in the development of safety work." Mr. Belnap will continue to exercise his usual functions under the Interstate Commerce Commission.

H. W. Belnap

OBITUARY

William Percy, for several years chief joint inspector at Los Angeles, Cal., died at Long Beach, Cal., on January 8, 1918.

SUPPLY TRADE NOTES

A. E. Crone has been elected vice-president and general manager of the Buffalo Brake Beam Company, New York.

The Schroeder Headlight Company, Inc., Evansville, Ind., has changed its name to the Schroeder Headlight & Generator Company.

L. A. Larsen, assistant to the president of the Lima Locomotive Works, Inc., has since February 13 also been secretary-treasurer, succeeding Mr. Cloos, resigned.

The Asbestos Protected Metal Company, Pittsburgh, Pa., announces the removal of its Boston office to the State Mutual building. The office will be in charge of W. H. Cummings.

C. H. Wilson, southwestern railroad representative for Fairbanks, Morse & Co., has been appointed first lieutenant in the Engineers' Reserve Corps and has been assigned to active duty.

J. A. McNulty, roundhouse foreman of the Chicago & North Western, at Chicago, has entered the railway sales department of the Anchor Packing Company, with headquarters at Chicago.

The Barco Manufacturing Company, successors to the Barco Brass & Joint Company, Chicago, has recently appointed the Holden Company, Ltd., of Montreal, as its exclusive Canadian agents.

The Westinghouse Electric & Manufacturing Company announces the removal of its office from Phoenix, Ariz., to Tucson, Ariz. Its representatives, J. H. Knost and W. G. Willson, will have headquarters in the Immigration building at the latter point.

W. S. King, formerly general superintendent of the Illinois Central, has entered the supply field, with offices in the McCormick building, 332 South Michigan avenue, Chicago. He will represent the Damascus Brake Beam Company and the Frost Railway Supply Company, and will also handle general railway supplies.

P. K. Aldrich, formerly with Edwin S. Woods & Co., Chicago, has formed the Superior Side Bearing Company, with offices at 922 Webster building, Chicago. Mr. Aldrich is president and general manager of the new company, which will manufacture side bearings with an intermediate support, and other railroad specialties.

J. B. Henry, general superintendent of the Union Steel Casting Company, Pittsburgh, has been elected vice-president, to succeed J. P. Allen, recently elected president of the company. Mr. Henry will continue to discharge the duties of general superintendent, as heretofore. W. C. Eichenlaub, secretary, has also been appointed manager of sales.

The L. S. Brach Supply Company, Newark, N. J., announces the following appointments: as superintendent. Henry Keohler, formerly of the Crucible Steel Company; as production engineers, Louis Rist, formerly with the Crocker-Wheeler Company, Ampere, N. J., and Herman Rose, formerly a foreman with the L. S. Brach Supply Company.

E. A. Simmons, president of the Simmons-Boardman Publishing Company, publishers of the Railway Age, *Railway Mechanical Engineer,* and other railway periodicals, and also president of the American Saw Mill Machinery Company, the American Tool Company and the American Saw Works, all of Hackettstown, N. J., has been commissioned a major in the Quartermaster Corps, National Army, reporting to the cantonment division at Washington.

The Walter A. Zelnicker Supply Company, St. Louis, has established permanent offices at Minneapolis, Minn., 627 Plymouth building, to serve the north central and Canadian trade. Richard K. Papin, formerly St. Louis and southwestern representative of the Davenport Locomotive Works and for ten years manager of the Zelnicker Company's equipment department, is in charge.

W. N. Thornburgh, vice-president and general manager of the Harrison Railway Specialties Company, Sandusky, O., will devote his entire time to his duties as president and treasurer of the William N. Thornburgh Company, manufacturers of the "National" steel and wood dust guard, and purchasers and sellers of used rails, cars and locomotives. He will have headquarters in Chicago, as heretofore.

B. S. Smith has been appointed circulation manager of the Simmons-Boardman Publishing Company, succeeding W. D. Horton, who has resigned to enter the sales department of the Patton Paint Company, Milwaukee, Wis. Mr. Smith has been employed as a subscription solicitor for the Railway Age, the *Railway Mechanical Engineer* and other Simmons-Boardman publications since October 1914. He enters upon his new duties, effective March 1.

H. S. Cooper, vice-president of the Independent Pneumatic Tool Company, manufacturers of pneumatic tools and electric drills, who for many years was the manager of the company's eastern branch in New York City, on February 1 assumed the duties of general sales manager as well as those of vice-president. His headquarters are at the general offices of the company, Thor building, Chicago. R. T. Scott, the former Pittsburgh branch office manager, has been promoted to the office of eastern manager, with headquarters at 170 Broadway, New York. H. F. Finney, who formerly traveled the Chicago and St. Louis territories, has been placed in charge of the company's branch office at Pittsburgh, Pa.

T. McCullum, formerly roundhouse foreman for the Duluth, Missabe & Northern, has been appointed railway representative for the Garratt-Callahan Company, Chicago, in charge of the northwest territory, with headquarters in Minneapolis, Minn. William Rollinson, foreman in the mechanical department of the Minneapolis, St. Paul & Sault Ste. Marie, has been appointed railroad representative in the states of Ohio, Indiana and Illinois, with headquarters at Indianapolis, Ind. George DuR. Fairleigh, formerly in the sales department of the U. S. Cast Iron Pipe Company, has been appointed railroad representative in the southwestern territory, with headquarters at Dallas, Tex. G. E. Wilson, formerly master mechanic for the Nevada Consolidated Copper Company, operating the Nevada Northern, has been appointed railway representative for the Pacific Coast territory, and will have his headquarters at San Francisco, Cal.

Goldschmidt Metal and Chemical Interests Combine

The business of both the Goldschmidt Detinning Company and the Goldschmidt Thermit Company will hereafter be conducted by the Metal & Thermit Corporation, with general offices at 120 Broadway, New York. These two concerns have been practically combined for the last two years and have occupied joint offices at the above address. The combination, which is controlled exclusively by Americans, has now been put in more permanent form, as it is felt that this will tend toward greater efficiency and co-ordination of effort.

The detinning department of the Metal & Thermit Corporation will carry on one of the largest industries of its kind in the world, i. e., the recovering of tin from tin scrap. Approximately 100,000 tons of tin scrap is treated yearly by this department and the recovery approximates the equivalent of 2,000 gross tons of metallic tin. The output of this branch

of the corporation consists of pig tin of a quality equalling Straits tin, tetrachloride of tin and detinned billets, the latter being the iron scrap after the tin is removed, which is compressed into billets and is used by iron and steel plants for remelting.

The Thermit welding process is used by practically all the railroads in the United States and Canada for welding broken locomotive frames and other heavy sections. It is also used very extensively by steel mills for welding broken equipment. Over 1,000,000 lb. of Thermit is used annually by these two industries alone. The Metal & Thermit Corporation operates four different plants, located respectively in Jersey City, Chrome, N. J.; Wyandotte, Mich., and East Chicago, Ind. The Chrome and East Chicago plants are devoted to the detinning industry; the Wyandotte plant to the production of liquid chlorine and the Jersey City plant to the Thermit products, including welding materials, carbon-free metals and alloys and pure Tungsten powder. The corporation operates branch offices and welding shops in Pittsburgh, Chicago, San Francisco and Toronto.

Chicago Railway Equipment Company Celebrates Its Twenty-fifth Anniversary

The Chicago Railway Equipment Company celebrated its "Silver" anniversary on the evening of February 5 at the Union League Club, Chicago. It was the twenty-fifth consecutive annual dinner held around the same table and in the same room. The participants included members of the organization, directors, shareholders and guests.

President E. B. Leigh, reviewing the progress of the company, said that in the quarter century the floor space devoted to the business of the company had increased from 30,000 sq. ft. to over 800,000 sq. ft., the total land owned to about 60 acres and the number of plants from one to five, located at Chicago, Detroit, Grand Rapids, Mich., Monon, Ind., and Franklin, Pa. Founded originally upon its brake beam business, the company had so far diversified its products that now about 70 per cent is sold to customers other than the railroads.

Mr. Leigh also told how the company had started with the original "Hein" (National Hollow) brake beam, and how at the expiration of the foundation patents fifteen years later it had in turn brought on the market the "Creco" brake beam. How effectively this worked out, he added, was "evidenced by the fact that so far as known not a single National Hollow brake beam has ever been manufactured or sold by any other than your own company."

The matter of standardization was commented on by Frank W. Noxon, secretary of the Railway Business Association, one of the guests.

In his remarks Mr. Noxon said:

"We have before us, when peace shall come, the project of reconstituting our whole railway system, in some way yet to be thought out, and to be debated out. We have a very animated, a very active, thorough-going propaganda, which has for its purpose to place all of the transportation agencies in the hands of the government. Of course, one of the first things that would result from that would be that the provision of appliances, the provision of rolling stock, and of tracks, of signals, and all those things would be centralized in the hands of some governmental agency.

"I have been wondering how, under such a system, it would be possible for a series of events to occur, such as we heard recorded to-night in these reports; how the event, which I noticed particularly, when at one stage a patent was about to run out, and when the inventive geniuses of the institution were set to work to provide an improvement over the old device—how such an event could come about.

"Naturally, if the government were to have in its hands the matter of developing the equipment, the men who now and in years past have devoted themselves to improvements in competition one with another, first asking the consideration of one railroad, and then finding that railroad indifferent, going to another, and so on until some hospitable mind was found—instead of that the purveyor or developer or inventor goes to some central board not composed of men who have direct personal interest at stake in proving their hospitality toward the new, but men perhaps overburdened with detail, tempted to standardize and overstandardize—and a deaf ear is turned, perhaps. Suppose it is—there is no recourse, there is no appeal. The improvement projected in the mind of the inventive genius is stopped, then and there.

"I question if men of the calibre of the men who have made this company what it is would be attracted to go in or stay in a business where the opportunity was in the hands, as it would be, of a government board.

"I just want to ask you to think of the great advantages, if we can have it, of maintaining some degree of decentralization, in the future, in the development of railway equipment.

"I think we all feel quite open-minded toward substantial changes from what has been in the past. We expect that what we have learned in the war will teach us things that we must apply and embody in a new system; and the question is whether or not we may have, when it is all over, sufficient decentralization so that the plans and schemes for the improvement of railroads may proceed from below, from the railroad managers themselves, and not from some bureau, static and stagnant, so that business men and inventors, men of imagination, will be attracted into that business, and the American people and the whole world have the benefit of rapid rather than slow progress."

Franklin Railway Supply Company of Canada, Ltd.

The Franklin Railway Supply Company of Canada, Limited, has taken over the business formerly handled by the Montreal branch of the Franklin Railway Supply Company, Inc. The new company will have exclusive rights in Canada to all the products of its parent company and will continue the same policies and business methods that have governed the Franklin Railway Supply Company, Inc., since its formation. The officers of the new company are: J. S. Coffin, chairman of the board; Joel S. Coffin, Jr., president, and Leland Brooks, vice-president. The company's headquarters will be at Montreal.

Joel S. Coffin, Jr., who has been elected president of the new company, brings to this new organization a wide experience in both the railroad supply business and locomotive building. He was born at Waukesha, Wis., and received his education at the public schools in Franklin, Pa., and Stevens Institute. After leaving Stevens he entered the service of the Venango Manufacturing Company at Franklin, Pa., and later served the American Locomotive Company in the erecting shop and as locomotive inspector. In 1912 he entered the employ of the Franklin Railway Supply Company as a service representative. He later went into the sales department and in 1915 was appointed Canadian sales manager which position he held up to the time of his recent election to the presidency of the Canadian corporation.

Leland Brooks, who has been elected vice-president of the Franklin Railway Supply Company of Canada, Ltd., was born at New York City and received his education in the public schools of that city and Stevens Institute. Upon leaving Stevens he entered the employ of the New York Central, serving seven years in the engineering department. Leaving the New York Central he took a position with the Franklin Railway Supply Company, Inc. For the past year he has been connected with its Canadian branch as assistant manager, which position he held up to the time of his recent election.